DOCUMENT RESUME

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TITLE	Military Curriculum Materials for Vocational and Technical Education. Plumbing Specialist II & III, 3-22.
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SPONS AGENCY	Office of Vocational and Adult Education (ED), Washington, DC.
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IDENTIFIERS	Military Curriculum Project

ABSTRACT

These military-developed curriculum materials consist of a course description, course chart, plan of instruction, lesson plans, study guides, and workbooks for use in training plumbing specialists II and III. Covered in the course blocks are building waste systems and exterior and interior supply systems. Course block II, on building waste systems, deals with building drains; vents and stacks; floor and roof drains; waste rough-in for lavatories; installation of back bents; rough-in for urinals, showers, tub drains, and water closet drains; and testing drainage systems. Addressed in course block III, on exterior and interior water supply systems, are the following topics: exterior water supply, steel pipe assembly, installation of building service lines, building distribution systems, copper tubing assembly, water supply rough-in for fixtures, and installation of domestic water heaters. (MN)

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MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
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- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL
Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

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The Ohio State University • 1960 Kenny Road • Columbus, Ohio 43210
Tel: (614) 486-3655 Cable: CTVOCEDOSU/Columbus, Ohio

Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL
Rebecca S. Douglass
Director
100 North First Street
Springfield, IL 62777
217/782-0759

NORTHWEST
William Daniels
Director
Building 17
Airdustrial Park
Olympia, WA 98504
206/753-0879

MIDWEST
Robert Patton
Director
1515 West Sixth Ave.
Stillwater, OK 74704
405/377-2000

SOUTHEAST
James F. Shill, Ph.D.
Director
Mississippi State University
Drawer DX
Mississippi State, MS 39762
601/325-2510

NORTHEAST
Joseph F. Kelly, Ph.D.
Director
225 West State Street
Trenton, NJ 08625
609/292-6562

WESTERN
Lawrence F. H. Zane, Ph.D.
Director
1776 University Ave.
Honolulu, HI 96822
808/948-7834

PLUMBING SPECIALIST II AND III

Table of Contents

Course Description Page 1

Course Chart Page 3

Plan of Instruction Page 6

Block II - Building Waste Systems

Lesson Plans Page 30

Building Waste Systems - Study Guides Page 120

Building Waste Systems - Workbooks Page 198

Block III - Exterior and Interior Water Supply Systems

Lesson Plans Page 241

Exterior and Interior Water Supply Systems - Study Guides Page 312

Exterior and Interior Water Supply Systems - Workbooks Page 373

Classroom Course 3-22

Developed by
United States Air Force

Development and Review Dates
July 2, 1975

D.O.T No.:
862.287

Occupational Area:
Building and Construction

Target Audiences:
Grades 10-adult

Print Pages
415

Cost:
$8.50

Availability:
Military Curriculum Project, The Center for Vocational Education, 1960 Kenny Rd., Columbus, OH 43210

Contents:	Type of Materials: Lesson Plans:	Programmed Text:	Student Workbook:	Handouts:	Text Materials:	Audio-Visuals:	Instructional Design: Performance Objectives:	Tests:	Review Exercises:	Additional Materials Required:	Type of Instruction: Group Instruction:	Individualized:
			No. of pages									
Block II												
Building Waste Systems	●		48		●	*	●	*		*	●	
Block III												
Exterior and Interior Supply Systems	●		30		●	*	●	*		*	●	

* Materials are recommended but not provided.

THE CENTER FOR VOCATIONAL EDUCATION

Expires July 1, 1978

2

Course Description

Because of its long length **Plumbing Specialist** has been divided into three (3) courses for inclusion in the "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education." Training for this series of courses includes instruction on plumbing system operating principles and configurations; construction and maintenance of fixtures, faucets, and plumbing system valves; and utilization and maintenance of tools, equipment, and supplies. The series involves 243 hours of instruction.

This is the second course in the series. It includes Block II—*Building Waste Systems* and Block III—*Exterior and Interior Supply Systems.* Students should not start **Plumbing Specialist, II and III** before they have completed **Plumbing Specialist, I** (course 3-21 in this catalog). The lesson titles and hours for the course are listed below:

Block II. — *Building Waste Systems* contains nine lessons with 58 hours of instruction.

Building Drains	(12 hours)
Vents and Stacks	(12 hours)
Floor Drains and Roof Drains	(3 hours)
Waste Rough-In for Lavatories	(3 hours)
Installation of Back Vents	(6 hours)
Rough-In for Urinal Drains	(6 hours)
Rough-In for Showers and Tub Drains	(6 hours)
Rough-In for Water Closet Drains	(6 hours)
Testing Drainage Systems	(4 hours)

Block III — *Exterior and Interior Water Supply Systems* contains seven lessons with 46 hours of instruction.

Exterior Water Supply	(3 hours)
Steel Pipe Assembly	(3 hours)
Installation of Building Service Lines	(6 hours)
Building Distribution Systems	(12 hours)
Copper Tubing Assembly	(12 hours)
Water Supply Rough-In for Fixtures	(6 hours)
Installation of Domestic Water Heaters	(4 hours)

Materials for both student and teacher use are included. Printed materials for the instructor include a plan of instruction for each block and lesson plans for each lesson. These contain an outline of instruction, objectives, activities, materials and tools needed, text assignments, and references. Student materials consist of study guides and workbooks for each block. Thirty-two slide sets and eight films are recommended for the series but these are not provided.

COURSE CHART

3-22

NUMBER 3ABR55235	PDS CODE ARL	DATE 2 July 1975
COURSE TITLE Plumbing Specialist		
ATC OPR AND APPROVAL DATE TTMS, 13 November 1974	CENTER OPR Sheppard/TTOXU	SUPERSEDES COURSE CHART 3ABR55235, 5 April 1973
DEPARTMENT OPR Department of Civil Engineering Training		APPLICABLE TRAINING STANDARD STS 552X5, 15 Feb 73; Ch1, 25 Feb74
LOCATION OF TRAINING Sheppard AFB, Texas		COURSE SECURITY CLASSIFICATION UNCLASSIFIED
INSTRUCTIONAL DESIGN Group/Lock Step: Proficiency Advancement		TARGET READING GRADE LEVEL FOR PREPARATION OF TRAINING LITERATURE 9

LENGTH OF TRAINING (9 Weeks, 0 Days)	Hours	
Technical Training		322
Classroom/Laboratory (C/L)	270	
Complementary Technical Training (CTT)	52	
Related Training		38
Standard Traffic Safety, Course I (AFR 50-24)	12	
Local Conditions Course, Course II (AFR 50-24)	2	
Supplemental Military Training (SMT) (ATCR 50-20)	12	
Commander's Calls/Briefings	2	
End of Course Appointments; Predeparture Safety Briefing (ATCR 127-1)	10	
Total		360

REMARKS

Effective date: 11 August 1975 with class 750811.

TABLE I - MAJOR ITEMS OF EQUIPMENT

Lavatory
Urinals
Valve Repair Kits
Water Heaters
Shower Unit
Water Closet
Grooving Tool
Tapping Machine
Test Plugs
Die Sets
Shop Benches
Power Grinder
Plumber Furnaces
Plumber Fire Pot
Sewer Augers
Centrifugal Pumps
Diaphragm Pump
Soil Pipe
Copper Pipe
Galvanized Pipe
Black Pipe
Vitrified Tile
Traps
Valves
Insulating Materials
Pipe Locator

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3ABR55235 **COURSE CHART – TABLE II – TRAINING CONTENT**

NOTE: Include time spent on technical training (TT) (classroom/laboratory (C/L) and complementary technical training (CTT)) and related training (RT). Exclude time spent on individual assistance (remedial instruction). A single entry of time shown for a unit is C/L time. When a double entry is shown, the second entry is CTT time.

WK OF TNG / HRS PER DAY	1 2 3 4 5 6	7 8
1 2(4/5)	Course Material - UNCLASSIFIED 54 Hours TT BLOCK I - Introduction to Plumbing Orientation (2 hrs); Career Field and Civil Engineer Organization (2 hrs); Plumbing Safety (2 hrs); Plumbing Systems, Terminology, and Engineering Drawings (12 hrs); Publications (6 hrs); Exterior Sewer Systems (4 hrs); Maintenance of Tools (2 hrs); Installation of Building Sewer Systems (6 hrs); Individual Waste Disposal Systems (12 hrs); Structural Openings (4 hrs); Measurement Test and Test Critique (2 hrs). (Safety as Applicable) 54 Hours C/L	18 Hours RT
2(1/5) 3 4(4/5)	Course Material - UNCLASSIFIED 72 Hours TT BLOCK II - Building Waste Systems Building Drains (12 hrs); Vents and Stacks (12 hrs); Floor Drains and Roof Drains (3 hrs); Waste Rough-In for Lavatories (3 hrs); Installation of Back Vents (6 hrs); Rough-In for Urinal Drains (6 hrs); Rough-In for Showers and Tub Drains (6 hrs); Rough-In for Water Closet Drains (6 hrs); Testing Drainage Systems (4 hrs); Measurement Test and Test Critique (2 hrs). (Safety as Applicable) 60 Hours C/L	8 Hours RT 12 Hours CTT
4(1/5) 5 6(2/5)	Course Material - UNCLASSIFIED 62 Hours TT BLOCK III - Exterior and Interior Water Supply Systems Exterior Water Supply (3 hrs); Steel Pipe Assembly (3 hrs); Installation of Building Service Lines (6 hrs); Building Distribution Systems (12 hrs); Copper Tubing Assembly (12 hrs); Water Supply Rough-In for Fixtures (6 hrs); Installation of Domestic Water Heaters (4 hrs); Measurement Test and Test Critique (2 hrs). (Safety as Applicable) 48 Hours C/L	2 Hours RT 14 Hours CTT

ATC FORM APR 73 449A PREVIOUS EDITION OBSOLETE.

COURSE CHART - TABLE II - TRAINING CONTENT 3ABR55235

NOTE: Include time spent on technical training (TT) (classroom/laboratory (C/L) and complementary technical training (CTT)) and related training (RT). Exclude time spent on individual assistance (remedial instruction). A single entry of time shown for a unit is C/L time. When a double entry is shown, the second entry is CTT time.

WK OF TNG \ HRS PER DAY	1 2 3 4 5 6	7 8
	Course Material - UNCLASSIFIED 80 Hours TT BLOCK IV - Fixtures and Appurtenances	20 Hours CTT
6(3/5) 7 8(2/5)	Installation of Bathtubs and Showers (6 hrs); Installation of Water Closets (6 hrs); Installation of Urinals (6 hrs); Installation of Lavatories (6 hrs); Insulation of Water Lines (6 hrs); Inspection and Maintenance of Plumbing Systems (6 hrs); Recovery and Restoration (12 hrs); Planning and Layout of Plumbing Systems (10 hrs); Measurement Test and Test Critique (2 hrs). (Safety as Applicable) 60 Hours C/L	
	Course Material - UNCLASSIFIED 54 Hours TT BLOCK V - Utility Equipment	6 Hours CTT
8(3/5) 9	Winterization of Piping (2 hrs); Maintenance of Valves (4 hrs); Maintenance of Sewers and Grease Traps (6 hrs); Emergency Maintenance of Exterior Piping (6 hrs); Fire Hydrants and Sprinkler Systems (12 hrs); Utility Equipment (6 hrs); Corrosion Control (3 hrs); Project and Resource Management (3 hrs); Communication Security (2 hrs); Measurement Test and Test Critique (2 hrs); Course Critique and Graduation (2 hrs). (Safety as Applicable) 48 Hours C/L	10 Hours RT

3-22

6

PLAN OF INSTRUCTION	COURSE TITLE Plumbing Specialist
BLOCK TITLE Building Waste Systems	

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2
1. **Building Drains**	12 (12/0) Days 10, 11
a. Given three pieces of plumbing materials, correctly identify each as to common name, size, material, and general application. All items must be correctly identified.	(1/0)
b. Using given instructions and plumbing symbols, draw a diagram of a building drain. Diagram must be complete enough to make a bill of materials.	(0.5/0)
c. Using a diagram of a building drain system, make a complete bill of materials. Bill of materials must contain the length and size of the pipe and the type and size of all fittings.	(0.5/0)
d. Using a measuring tape or rule, measure and mark pipe to within ± 1/8 inch of specific length.	(0.5/0)
e. Cut cast iron pipe to a specified length ± 1/8 inch using a cold chisel and hammer.	(0.5/0)
f. Cut cast iron pipe to a specified length ± 1/8 inch using a snap cutter.	(0.5/0)

SUPPORT MATERIALS AND GUIDANCE 3

Column 1 Reference	STS Reference
1a	6b(1)
1b	8d
1c	8c(2)
1d	11e(1)
1e	11e(8)
1f	11e(7)
1g	11e(2)
1h	3a(4), 3a(5)
1i	3a(4), 3a(5)
1j	3a(4), 3a(5), 11f(6)
1k	11e(1), 11e(7), 11f(6), 11i

Instructional Materials

SG 3ABR55235-II-1, Building Drains
WB 3ABR55235-II-1-P1, Building Drains
WB 3ABR55235-II-1-P2, Cutting and Fabricating Four-Inch Cast Iron Pipe

Audio Visual Aids

Slides, Progression of Building Waste Systems

Training Equipment

Hand Tools for Plumbing (1)
Plumber's Furnace (2)
Shop Tools for Plumbing (2)

PLAN OF INSTRUCTION NO. 3ABR55235	DATE Changed 20 January 1976	BLOCK NO. II	PAGE NO. 17

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2
g. Using a hacksaw and adjustable jaw wrench, cut one-half inch, ± 1/8 inch, from the end of a cast iron pipe.	(0.5/0)
h. Using given procedures, move and store propane gas containers. Containers must be stored and secured in accordance with given instructions.	(0.5/0)
i. Using given procedures, assemble and operate a plumber's furnace. The lead pot must set firmly on the stand and the flame must be adjusted to maintain the lead in a molten state with a metallic blue tinge.	(0.5/0)
j. Assemble and pour a horizontal joint, using training aids. Lead ring must be 3/4" to 1" in depth.	(1/0)
k. Using given procedures, construct a building drain in the booth area. Pipe must be graded 1/4 inch per foot.	(6/0)

SUPPORT MATERIALS AND GUIDANCE 3

Training Methods
Discussion and Demonstration (4 hrs)
Performance (8 hrs)

Instructional Environment/Design
Classroom (3 hrs)
Laboratory (9 hrs)
Group/Lockstep: Proficiency Advancement

Instructional Guidance
Use slides when discussing the construction and operation of a building drain system. Identify the parts of the system. Discuss the application of codes in the placement of vents, pipe support, and grade. Show sample of hardware used. Have the students identify building drain parts and fittings. Demonstrate the cutting of cast iron pipe using a hammer and chisel. Permit the students to practice on waste pieces. Emphasize cutting hazards and precautions. Demonstrate the application of oakum. Demonstrate the techniques to be used when measuring pipe using bell and spigot joints. Discuss the hazards and safe handling of bottles of compressed gas. Demonstrate the operation of a furnace and stress the hazards and precautions to be used when operating the furnace. Use the trainer to demonstrate pouring vertical and horizontal joints. Again emphasize safety hazards and precautions when handling hot lead. Monitor students as they practice preparing vertical and horizontal lead joints. Demonstrate the use of snap and chain cutter. Have students complete the work projects.

The following references should be used in preparing the lesson:
TO 40P-1-131, Plumbing and Pipe Fittings
AFR 127-101, Ground Accident Prevention Handbook
National Plumbing Code

PLAN OF INSTRUCTION NO.	DATE	BLOCK NO.	PAGE NO.
3ABR55235	Changed 20 January 1976	II	18

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
2. Vents and Stacks	12 (12/0) Days 12, 13	**Column 1 Reference** — **STS Reference** 2a — 6a(3), 8a, 8c(1) 2b — 6a(3), 8d 2c — 8c(2) 2d — 11f(6), 11g, 11i **Instructional Materials** SG 3ABR55235-II-2, Vents and Stacks WB 3ABR55235-II-2-P1, Components of Building Drain and Vent System WB 3ABR55235-II-2-P2, Fabricating Vents and Stacks WB 3ABR55235-II-2-P3, Grading Pipe WB 3ABR55235-II-2-P4, Attaching Pipe to Building Structure Rough-In Specifications and Drawings **Audio Visual Aids** Slides, Progression of Building Waste System **Training Equipment** Hand Tools for Plumbing (1) Plumber's Furnace (2) Shop Tools for Plumbing (2) **Training Methods** Discussion and Demonstration (3 hrs) Performance (9 hrs)
a. Given a drawing of a plumbing system, determine the type of vent and stack system used.	(2/0)	
b. Following given instructions, make a working drawing of a plumbing vent system and name the fittings. Drawing must be complete.	(2/0)	
c. Using your working drawing, select all the soil pipe and fittings required to construct a main vent stack in the booth area.	(2/0)	
d. Following given instructions and working as a member of a team, assemble a vent and stack system in the assigned booth area. Pipe must be aligned within ± 1/2 inch of given specifications.	(6/0)	

PLAN OF INSTRUCTION NO. 3ABR55235 | DATE 2 July 1975 | BLOCK NO. II | PAGE NO. 19

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Instructional Environment/Design Classroom (3 hrs) Laboratory (9 hrs) Group/Lockstep:Proficiency Advancement Instructional Guidance During the discussion of the vent system, point out the need for various type stacks, traps, and vents. Explain the extent that codes influence construction and design of venting systems. Give the students a drawing of the booth area main vent and drain systems, and have them select the required pipe and fittings to construct the system. Demonstrate the assembly of no-hub cast iron. Demonstrate the use of a plumb bob in positioning fittings under the booth area. Stress safety hazards when lifting heavy loads and when using the furnace and hot lead. Closely monitor the students as they assemble the main vent and drain system. Have the students complete the work projects. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. II	PAGE NO. 20

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
3. Floor Drains and Roof Drains a. Given a sketch of a roof and floor drain system, make a bill of materials for the installation of a drain system. Bill of materials must contain the length, type and size of all pipe and the type and size of all fittings.	4 (3/1) Day 14 (3/1)	Column 1 Reference: 3a STS Reference: 6a(4), 13a(5), 14b Instructional Materials SG 3ABR55235-II-3, Floor Drains and Roof Drains WB 3ABR55235-II-3-P1, Floor and Roof Drains Audio Visual Aids Slides, Roof, Floor Drains Training Methods Discussion and Demonstration (2 hrs) Performance (1 hr) Outside Assignment (1 hr) Instructional Environment/Design Classroom (3 hrs) Laboratory (1 hr) Group/Lockstep: Proficiency Advancement Study Hall (Dormitory)(1 hr) Instructional Guidance Discuss the types and purposes of roof and floor drains. Show the differences between inside and outside roof drain systems. Mention the codes governing the connection of roof and street drains into the main sewers. Discuss single and multiple drain systems and components. Discuss pipe support methods. Monitor students as they complete workbook projects.

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
4. Waste Rough-In for Lavatories	4 (3/1) Day 14	**Column 1 Reference** — **STS Reference** 4a — 6a(3), 6a(4), 8c(1), 8c(2), 14a 4b — 6a(3), 6a(4), 8c(1), 8c(2), 14a **Instructional Materials** SG 3ABR55235-II-4, Waste Rough-In for Lavatories WB 3ABR55235-II-4-P1, Waste Rough-In for Lavatories Rough-In Specifications and Drawings **Audio Visual Aids** Slides, Progression of Building Waste System **Training Methods** Discussion and Demonstration (2 hrs) Performance (1 hr) Outside Assignment (1 hr) **Instructional Environment/Design** Classroom (2 hrs) Laboratory (1 hr) Group/Lockstep:Proficiency Advancement Study Hall (Dormitory)(1 hr) **Instructional Guidance** Discuss the waste rough-in for lavatories and explain how it differs from the waste rough-in for other items. Show the slides in the progression of building waste systems and have the students answer questions over the key points illustrated in the slides. Have the students complete the work projects and check their list of required materials. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment at the end of day 14: Read SG 3ABR55235-II-5 and answer the questions at the end of the study guide. Complete WB 3ABR55235-II-5-P1 and be prepared for a quiz at the beginning of day 15.
a. Given the rough-in specifications for a lavatory, correctly answer four questions concerning the installation of lavatories	(1/0)	
b. Given a shop drawing of a lavatory drain system, determine the plumbing installation method required, and make a list of all the material needed to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excesses greater than 10%.	(2/1)	

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. II	PAGE NO. 22

12

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
5. Installation of Back Vents	8 (6/2) Day 15	Column 1 Reference — STS Reference 5a — 6a(3), 8c(2) 5b — 3a(1), 11e(1), 11e(2), 11e(4) 5c — 3a(1), 11e(10) 5d — 11e(11) 5e — 11f(1) Instructional Materials SG 3ABR55235-II-5, Installation of Back Vents WB 3ABR55235-II-5-P1, Installation of Back Vents Rough-In Specifications and Drawings Audio Visual Aids Slides, Progression of Building Waste System Training Equipment Hand Tools for Plumbing (1) Plumber's Furnace (8) Shop Tools for Plumbing (2) Training Methods Discussion (2 hrs) Performance (4 hrs) Outside Assignment (2 hrs) Instructional Environment/Design Classroom (2 hrs) Laboratory (4 hrs) Group/Lockstep:Proficiency Advancement Study Hall (Dormitory)(2 hrs)
a. Using shop drawings of a back vent system, make a list of all of the materials required to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.	(0.5/.2)	
b. Using either a hand-operated pipe cutter or hacksaw, cut steel pipe to a given length ± 1/8 inch.	(2/.5)	
c. Using either a reamer or a suitable file, dress a pipe end. All burrs must be removed and the inner surface of the pipe must be returned to its original diameter.	(0.5/.3)	
d. Using a hand stock and die set, thread a piece of steel pipe. Three threads must extend beyond the face of the die segment.	(1/.5)	
e. Assemble threaded pipe and fittings. Completed joint must be water tight.	(2/.5)	

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE	
		Instructional Guidance Use slide when describing the types and operation of lavatory vent systems. Use drawings of vent system when describing the materials, fittings, and joints. Demonstrate cutting, reaming, and the use of manual threaders. Emphasize safety in the handling of tools, equipment, and pipe. Discuss the importance of thread sizes and lengths versus pipe size and material composition. Have students practice cutting, reaming and threading before assembling the system. Monitor all student activities and enforce safety precautions. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment: Read SG 3ABR55235-II-6, and answer questions at the end of the SG. Complete WB 3ABR55235-II-6-P1 and be prepared for a quiz at the beginning of day 16.	
6. Rough-In for Urinal Drains	8	Column 1 Reference	STS Reference
	(6/2)	6a	6a(3)
	Day 16	6b	8c(2)
a. Given an illustration of three types of urinal vents, correctly name each type.	(0.5/.5)	6c	11f(6), 14a
b. Using a working drawing, make a bill of materials for the construction of a urinal vent and drain system. The list of materials must accurately identify all required materials without shortage, and without excess greater than 10%.	(0.5/0)	Instructional Materials SG 3ABR55235-II-6, Rough-In for Urinal Drains WB 3ABR55235-II-6-P1, Installation of Urinal Waste and Venting Rough-In Specifications and Drawings Audio Visual Aids Slides, Progression of Building Waste Systems	
c. Following the prescribed procedures and working as a member of a team, install a urinal waste and vent system in the booth area. The drainage tee must be within 1/4 inch of the center of the existing hole.	(5/1.5)	Training Equipment Hand Tools for Plumbing (1) Shop Tools for Plumbing (2) Plumber's Furnace (2)	

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Training Methods Discussion and Demonstration (2 hrs) Performance (4 hrs) Outside Assignment (2 hrs) **Instructional Environment/Design** Classroom (2 hrs) Laboratory (4 hrs) Group/Lockstep: Proficiency Advancement Study Hall (Dormitory)(2 hrs) **Instructional Guidance** Using drawings of urinal vents and drain systems, describe their construction. Have the students complete the workbooks. Enforce safety. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment: Read SG 3ABR55235-II-7 and answer questions at the end of the SG. Complete WB 3ABR55235-II 7-P1 and be prepared for a quiz over the subject at the beginning of day 17.
7. Rough-In Showers and Tub Drains	8 (6/2) Day 17	**Column 1 Reference** — **STS Reference** 7a — 6a(3) 7b — 13a(5), 14a
a. Using the illustrations provided, identify the components of a shower and tub drain system. All eight items must be identified correctly.	(1/.5)	**Instructional Materials** SG 3ABR55235-II-7, Rough-In for Showers and Tub Drains WB 3ABR55235-II-7-P1, Rough-In Piping for Showers Rough-In Specifications
b. Following the prescribed procedures and working as a member of a team, install a shower drain system in the booth area. The shower strainer must be within 1/4 inch of the center of the existing hole.	(5/1.5)	**Audio Visual Aids** Slides, Bathtub

15

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Training Equipment Hand Tools for Plumbing (1) Shop Tools for Plumbing (2) **Training Methods** Discussion (1 hr) Performance (5 hrs) Outside Assignment (2 hrs) **Instructional Environment/Design** Classroom (1 hr) Laboratory (5 hrs) Group/Lockstep:Proficiency Advancement Study Hall (Dormitory)(2 hrs) **Instructional Guidance** Use illustrations and samples while discussing bathtub and shower installation. Identify the traps used. Discuss the codes governing bathtub vent and drain systems. Identify the hardware used. Have the students select the materials and tools needed to fabricate a bathtub drain. Have the students complete the work project. Give assistance as required and enforce safety practices. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment: Read SG 3ABR55235-II-8 and answer questions at end of the SG. Complete WB 3ABR55235-II-8-P1.
8. Rough-In for Water Closet Drains a. Given a sketch of a single water closet installation, locate and name each component in the vent and drain system. All nine items must be identified correctly.	8 (6/2) Day 18 (1/.5)	**Column 1 Reference** — **STS Reference** 8a — 6a(3) 8b — 8c(2) 8c — 3a(4), 11f(6)

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. II	PAGE NO. 26

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
b. Given a sketch of a vent and drain system for a water closet, make a bill of materials and select the necessary pipe and fittings to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.	(1/.5)	**Instructional Materials** SG 3ABR55235-II-8, Rough-In for Water Closet Drains WB 3ABR55235-II-8-P1, Installing Waste Rough-In for Water Closets **Audio Visual Aids** Slides, Water Closet Rough-In **Training Equipment** Hand Tools for Plumbing (1) Shop Tools for Plumbing (2) **Training Methods** Discussion and Demonstration (2 hrs) Performance (4 hrs) Outside Assignment (2 hrs) **Instructional Environment/Design** Classroom (2 hrs) Laboratory (4 hrs) Group/Lockstep:Proficiency Advancement Study Hall (Dormitory)(2 hrs) **Instructional Guidance** Discuss water closet drainage methods, types of material required to rough in a water closet, and the method of pouring horizontal joints. Use shop drawing and manufacturer's specifications in determining the measurements for a rough-in water closet system. Explain installing closet flange, cleaning tools, and equipment. Emphasize safety in roughing in water closet drainage system. Have the students complete the work project. The following references should be used in preparing the lesson: AFM 85-20, Plumbing; AFR 127-101, Ground Accident Prevention Handbook; National Plumbing Code. Make the following outside assignment: Read SG 3ABR55235-II-9 and answer questions at the end of the SG. Complete WB 3ABR55235-II-9-P1 and be prepared for a quiz at the beginning of day 19.
c. Working as a member of a team and following given instructions, construct a vent and drain system for a water closet. All measurements must be within ± 1/4 inch of given specifications.	(4/1)	

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)
9. Testing Drainage Systems	6 (4/2) Day 19
a. Given the necessary tools and equipment and working as a member of a team, perform a water leak test on a newly constructed waste system. Locate all leaks.	(2/1)
b. Using the tools and material provided, repair one of each type leak located.	(2/1)

3 SUPPORT MATERIALS AND GUIDANCE

Column 1 Reference	STS Reference
9a	10c
9b	12a

Instructional Materials
SG 3ABR55235-II-9, Testing Drainage Systems
WB 3ABR55235-II-9-P1, Testing Building Waste Systems
Shop Drawings

Audio Visual Aids
Slides, Testing Water System

Training Equipment
Hand Tools for Plumbing (1)
Shop Tools for Plumbing (2)

Training Methods
Discussion and Demonstration (2 hrs)
Performance (2 hrs)
Outside Assignment (2 hrs)

Instructional Environment/Design
Classroom (2 hrs)
Laboratory (2 hrs)
Group/Lockstep:Proficiency Advancement
Study Hall (Dormitory)(2 hrs)

Instructional Guidance
Discuss waste system acceptability standards. Use slides while describing various plugs, caps, and other devices used to plug a pipe system while testing for leaks. Discuss various methods of testing pipe for leaks. Describe procedures for stopping leaking in caulked and threaded joints. Discuss the alternatives should initial efforts to stop leaks fail. Describe installation of joints when replacing pipe and fittings. Demonstrate measuring techniques when replacing pipe in

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		established pipe systems. Have students perform leak test, using water. Have them perform necessary repair of leaking joints. Monitor students activities, being alert for safety hazards. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment at the end of day 19: Read SG 3ABR55235-III-1 and answer questions at the end of the study guide. Complete Mission 1 of WB 3ABR55235-III-1-P1 and be prepared for a quiz at the beginning of day 20.
10. Related Training (as shown on the course chart)	8	
11. Measurement Test and Test Critique	2 (2/0) Day 19	

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. II	PAGE NO. 29

PLAN OF INSTRUCTION	COURSE TITLE Plumbing Specialist

BLOCK TITLE

Exterior and Interior Water Supply System

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
1. Exterior Water Supply	3 (3/0) Day 20	Column 1 Reference — STS Reference 1a — 6a(1), 8a 1b — 11f(3), 11f(7) 1c — 11e(6) Instructional Materials SG 3ABR55235-III-1, Exterior Water Supply WB 3ABR55235-III-1-P1, Constructing a Water Distribution System Map of the Base Water Distribution System Audio Visual Aids Slides, Exterior Water System Training Equipment Sample Board of Plumbing Hardware (12) Shop Tools for Plumbing (2) Training Methods Discussion and Demonstration (1 hr) Performance (2 hrs) Instructional Environment/Design Classroom (1 hr) Laboratory (2 hrs) Group/Lockstep:Proficiency Advancement
a. Given a drawing or map of an exterior water supply system, locate and name the major components. All six components must be named correctly.	(1/0)	
b. Using given information, list the steps necessary to assemble cement asbestos pipe using a rolling ring and flanged pipe and fittings. All the steps must be in correct sequence.	(1/0)	
c. Working as a member of a team, cut cast iron pipe to a given length ± 1/8 inch with a chain cutter.	(1/0)	

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. III	PAGE NO. 30

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Instructional Guidance Use slides of a base water distribution system when discussing the system's components and their location. Discuss the nature of water and the factors that determine pressure and quality requirements. Use a map to locate the approximate position of the water main to the buildings nearby. Identify samples of water pipe used in water main construction and discuss various methods of assembling the pipe. Demonstrate how pipe connections are made and use slides to show the types of connections not available. Demonstrate the chain cutter in cutting a piece of cast iron pipe. Monitor students to insure that proper pipe holding and support techniques are being practiced. Have the students complete the workbook projects. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code
2. Steel Pipe Assembly	3 (3/0)	Column 1 Reference STS Reference 2a 3b, 11e(4), 11e(11) 2b 11f(1)
a. Using a power threader, cut, ream, and thread steel pipe. Finished work must be within ± 1/8 inch of given measurements.	Day 20 (1.5/0)	Instructional Materials SG 3ABR55235-III-2, Steel Pipe Assembly
b. Using given instructions, assemble a piece of threaded steel pipe and a 90 degree elbow. The finished connection must be within ± 1/8 inch, of specifications measured from end to center.	(1.5/0)	WB 3ABR55235-III-2-P1, Cutting, Threading, and Assembling Steel Pipe Audio Visual Aids Training Film, FLC 3/150, Choosing the Right Valve

PLAN OF INSTRUCTION (Continued)

<table>
<tr><th>UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1</th><th>DURATION (HOURS) 2</th><th>SUPPORT MATERIALS AND GUIDANCE 3</th></tr>
<tr><td></td><td></td><td>

Training Equipment
Shop Tools for Plumbing (2)
Power Threader (2)

Training Methods
Discussion and Demonstration (1 hr)
Performance (2 hrs)

Instructional Environment/Design
Classroom (1 hr)
Laboratory (2 hrs)
Group/Lockstep: Proficiency Advancement

Instructional Guidance
Discuss the types of pipe cutters such as the one- and three-wheel cutter and the situation in which each should be used. Discuss the proper inspection and use of the hacksaw in cutting steel pipe. Discuss thread depth and its relationship to pipe wall thickness and strength. Demonstrate the use of power equipment in cutting and threading steel pipe. Have the students accomplish the workbook project. Follow safety precautions when operating the machinery.

</td></tr>
<tr><td>3. Installation of Building Service Lines

a. Given a sketch of a typical building service line, locate, name, and give the purpose of each major component. All six components must be identified correctly.</td><td>8
(6/2)
Day 21
(0.5/0)</td><td>
<table>
<tr><th>Column 1 Reference</th><th>STS Reference</th></tr>
<tr><td>3a</td><td>6a(2), 13a(4)</td></tr>
<tr><td>3b</td><td>6a(2), 8d</td></tr>
<tr><td>3c</td><td>6a(2), 8c</td></tr>
<tr><td>3d</td><td>11e(15)(a), 11e(15)(b)</td></tr>
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PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
b. Make a drawing of a building service line and label each component. Retain this information as it will be used later.	(0.5/1)	**Instructional Materials** SG 3ABR55235-III-3, Installation of Building Service Lines WB 3ABR55235-III-3-P1, Tapping Pressurized Water Main
c. Using a drawing of a building service line, make a list of the materials needed to construct a service line. The bill of materials must accurately identify all the required materials without shortages and without excess greater than 10%.	(1/.5)	**Audio Visual Aids** Training Film: CE-10, Water Main Self-Tapping Machine Slides, Building Service Lines **Training Equipment** Main Tapping Machine (12) Hand Tools for Plumbing (1)
d. Using the self-tapping machine and the procedures outlined in training film CE-10, tap a pressurized water main and install a corporation stop. Completed work must withstand line pressure without leaking.	(4/.5)	Special and Shop Tools for Plumbing (2) Samples of Plumbing Hardware (12) Water Main Trainer (12) **Training Methods** Discussion and Demonstration (3 hrs) Performance (3 hrs) Outside Assignment (2 hrs) **Instructional Environment/Design** Classroom (3 hrs) Laboratory (3 hrs) Group/Lockstep:Proficiency Advancement Study Hall (Dormitory)(2 hrs) **Instructional Guidance** Use slides of building service line and samples of the system components. Discuss valves, meters, flexible connections and pipe sizing. Have the students draw a service line. Have the students make a material list of the system. Show the film on the demonstration of the self-tapping

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		machine. Have the sutdents tap at least one hole. Have them install a corporation stop. Have the students fabricate and install a short nipple and pipe union. Do not permit students to go beyond this point until the lesson on building distribution system has been completed. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment; Read SG 3ABR55235-III-3 and answer the questions at the end of the text.
4. Building Distribution Systems	16 (12/4) Days 22 and 23	Column 1 Reference STS Reference 4a 6a(2), 6a(7) 4b 6a(2), 6a(7), 8d 4c 6a(2), 6a(7), 11f(1), 11g
a. Using blueprints or drawings, locate and name three major components of a typical building cold water distribution system. The three components must be named correctly.	(1/1)	Instructional Materials SG 3ABR55235-III-4, Building Distribution Systems WB 3ABR55235-III-4-P1, Installation of Building Cold Water Distribution System
b. Using given instructions, make a sketch of the cold water distribution system in the booth area. Sketch must be complete enough to be used to construct the system.	(5/1)	Blueprints and Drawings Training Equipment Hand Tools for Plumbing (1) Shop Tools for Plumbing (2)
c. Following the procedures provided, construct a cold water distribution system in the booth area. All measurements must be within ± 1/4 inch of specifications.	(6/2)	Training Methods Discussion and Demonstration (4 hrs) Performance (8 hrs) Outside Assignments (4 hrs) Instructional Environment/Design Classroom (4 hrs) Laboratory (8 hrs) Group/Lockstep: Proficiency Advancement Study Hall (Dormitory)(4 hrs)

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
		Instructional Guidance Discuss the components of a typical building cold water distribution system. Discuss measuring and assembly procedures. Emphasize safety in use of power equipment. Students should use power equipment more extensively during this lesson than any previous lesson. Have the students make a sketch of a distribution system, using the proper symbols. Discuss the location of fixtures and pipe support devices. Have the students install all parts of the distribution system except the risers. The system should include a branch line to the water heater. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code Make the following outside assignment: For Day 22 have the students study 3ABR55235-III-4. For Day 23 have the students review 3ABR55235-III-4 and study WB 3ABR55235-III-4-P1.
5. Copper Tubing Assembly	16 (12/4) Days 24 and 25	
a. Using a working drawing, make a list of the materials required to construct a hot-water distribution system in the booth area. The list must accurately identify all of the required materials without shortages and without excess greater than 10%.	(2/1)	
b. Following the procedures provided, measure, cut, ream, bend, and flare copper tubing. End-to-center measurements must be within ± 1/4 inch of specifications and the flare must completely fill the flare nut without binding.	(4/1)	

Column 1 Reference	STS Reference
5a	6a(7), 8c(2)
5b	6b(1), 11e(1), 11e(2), 11e(5), 11e(9), 11e(10), 11e(13), 11f(9)(a)
5c	6b(2), 11e(2), 11e(5), 11e(10), 11e(14)
5d	3a(5), 3a(6), 11f(9)(c)
5e	11f(9)(b)
5f	11e(1), 11e(2), 11e(9), 11e(10), 11e(13), 11e(14)

Instructional Materials

SG 3ABR55235-III-5, Copper Tubing Assembly
WB 3ABR55235-III-5-P1, Bill of Materials
WB 3ABR55235-III-5-P2, Assembling Flared and Soldered Copper Joints
WB 3ABR55235-III-5-P3, Swedging and Soldering
WB 3ABR55235-III-5-P4, Making a Ferruled Connection
WB 3ABR55235-III-5-P5, Installation of Building Hot Water Distribution System

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
c. Using the instructions and materials provided, make a swedged connection in copper tubing. Completed swedge must be straight with the tubing and be the depth and diameter of the swedging tool.	(.5/0)	Audio Visual Aids Training Film: TF1 4082, Refrigeration and Repair Tube Connections Training Equipment Hand Tools for Plumbing(1) Shop Tools for Plumbing(2)
d. Using given instructions and an acetylene or propane torch, solder a swedged connection. Solder must be visible (in the joint) completely around the tubing.	(.5/0)	**Training Methods** Discussion and Demonstration (4 hrs) Performance (8 hrs) Outside Assignments (4 hrs)
e. Using given instructions, make a ferruled connection in copper tubing. The finished connection must withstand base water pressure without leaking.	(1/1)	**Instructional Environment/Design** Classroom (4 hrs) Laboratory (8 hrs) Study Hall (Dormitory)(4 hrs) Group/Lockstep:Proficiency Advancement
f. Using your working drawing and the required bill of materials, construct a hot water distribution system. All measurements must be within 1/4 inch of specifications.	(4/1)	**Instructional Guidance** Explain the characteristics and application of copper and plastic pipe and tubing. Demonstrate how to measure, bend, cut, flare, and swedge copper tubing. Demonstrate how to light, adjust and use an acetylene or propane torch. Emphasize safety. Have the students complete the work projects and check their completed work. Make the following outside assignment: For day 24 have the students study SG 3ABR55235-III-5. For day 25 have the students study WBs 3ABR55235-III-5-P3, P4, and P5. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
6. **Water Supply Rough-In for Fixtures** a. Using a plumber's sketch and manufacturer's rough-in specifications, make a list of the materials required and determine the procedures necessary to install the water supply for booth area fixtures. The bill of material must accurately identify all of the required materials without shortages and without excess greater than 10%.	8 (6/2) Day 26 (1/1)	Column 1 Reference — STS Reference 6a — 6a(7), 8c(1), 8c(2), 14b 6b — 11e(1), 11f(1), 11h, 12c, 14a, 14b Instructional Materials SG 3ABR55235-III-6, Water Supply Rough-In for Fixtures WB 3ABR55235-III-6-P1, Rough-In Water Supply for Bathroom Fixtures Manufacturer's Rough-In Specifications Engineering Drawings Audio Visual Aids Slides, Water Supply Rough-In for Lavatory, Urinals and Water Closets Training Equipment Hand Tools for Plumbing (1) Shop Tools for Plumbing (2) Training Methods Discussion and Demonstration (1 hr) Performance (5 hrs) Outside Assignment (2 hrs) Instructional Environment/Design Classroom (1 hr) Laboratory (5 hrs) Study Hall (Dormitory)(2 hrs) Group/Lockstep:Proficiency Advancement
b. Using given instructions, rough in the water supply for the fixtures in the booth area, installing air chambers and electrical insulating fittings as required. The water supply must be ready for the fixture. The air chambers must eliminate the possibilities of water hammer and the insulating fitting must be installed correctly.	(5/1)	

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Instructional Guidance Demonstrate the use of rough-in specifications in fabricating supply lines to bathroom fixtures. Discuss the codes governing pipe sizing to fixtures. Call attention to specifications in identifying fixtures to be installed. Discuss purpose and locations of air chambers. Have the students select the necessary materials to fabricate steel and copper supply lines as per specifications and codes. Have the student complete the work project. Check the students' completed workbooks. At the end of day 26, make the following outside assignment: Read SG 3ABR55235-III-7, and answer the question. Study the procedures roughing in the water supply for showers in WB 3ABR55235-III-7-P1. Review for a test over block III. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code
7. Installation of Domestic Water Heaters a. Using the diagram provided, locate and name the major components of gas and electric water heaters. The eight components of the gas burner and the nine components of the water heater must be named correctly.	6 (4/2) Day 27 (3/1)	**Column 1 Reference** **STS Reference** 7a 14d 7b 3a(7), 3a(10), 14d **Instructional Materials** SG 3ABR55235-III-7, Installation of Domestic Water Heaters WB 3ABR55235-III-7-P1, Installing a Gas Water Heater Manufacturer's Rough-In Specifications
b. Install and light a gas water heater. The piping must not leak and the air-gas mixture must be adjusted to produce a blue flame with a yellow tip.	(1/1)	**Audio Visual Aids** Slides, Water Heaters

28

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Training Equipment Hand Tools for Plumbing (1) Shop Tools for Plumbing (2) Water Heater (2)
		Training Methods Discussion and Demonstration (2 hrs) Performance (2 hrs) Outside Assignments (2 hrs)
		Instructional Environment/Design Classroom (2 hrs) Laboratory (2 hrs) Study Hall (Dormitory)(2 hrs) Group/Lockstep:Proficiency Advancement
		Instructional Guidance Discuss the types of water heaters and the operation of a typical domestic water heater. Discuss the fabrication and installation of gas supply lines. Discuss the methods of performing leak tests on gas and air systems. Have the students fabricate and install a water and gas line to a water heater. Test the gas connections for leaks. Demonstrate the lighting and adjusting procedures. Have each student light and adjust the burners
		At the end of day 27, make the following outside assignment: Read SG 3ABR55235-IV-1, and answer the questions. Be prepared for a test over this material. The following references should be used in preparing the lesson: AFR 127-101, Ground Accident Prevention Handbook National Plumbing Code

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. III	PAGE NO. 39

29

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
8. Related Training (as shown on the course chart)	2	
9. Measurement Test and Test Critique	2 (2/0) Day 27	

PLAN OF INSTRUCTION NO. 3ABR55235	DATE 2 July 1975	BLOCK NO. III	PAGE NO. 40

3-22 30

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/20Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste System

LESSON TITLE
Building Drains (Days 10 and 11)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
12 Hrs	0	12 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
17	2 July 1975	1

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 February 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Handtools Plumber's Furnace Shop Tools	C.I. Fittings Oakum Lead Compressed gas cylinder	None	SG II-1 WB II-1-P1 and P2 Slides: Progression of Building Waste System

CRITERION OBJECTIVES AND TEACHING STEPS

1a. Given three pieces of plumbing materials, correctly identify each as to common name, size, material, and general application. All items must be correctly identified.

(1) Definition of a building drain
(2) Location
(3) Type of material used

1b. Using given instructions and plumbing symbols, draw a diagram of a building drain. Diagram must be complete enough to make a bill of materials.

(1) Blueprints
(2) Working drawings
(3) Symbols and fittings

ATC FORM AUG 72 770

(4) Manufacturer's rough-in specifications
(5) Specification sheets
(6) Codes

1c. Using a diagram of a building drain system, make a complete bill of materials. Bill of materials must contain the length and size of the pipe and the type and size of all fittings.

(1) Definition
(2) Take off items
(3) Purpose

1d. Using a measuring tape or rule, measure and mark pipe to within ± 1/8 inch of specific length.

(1) Hub to spigot
(2) Fittings

1e. Cut cast iron pipe to a specified length ± 1/8 inch using a cold chisel and hammer.

(1) Oldest method
(2) Safety

1f. Cut cast iron pipe to a specified length ± 1/8 inch using a snap cutter.

(1) Sound out pipe
(2) Safety

1g. Using a hacksaw and adjustable jaw wrench, cut one-half inch, ± 1/8 inch, from the end of a cast iron pipe.

(1) Sound out pipe
(2) Use on cuts near end of pipe
(3) Safety
(4) Other methods

1h. Using given procedures, move and store propane gas containers. Containers must be stored and secured in accordance with given instructions.

(1) Moving
(2) Storage

LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

1i. Using given procedures, assemble and operate a plumber's furnace. The lead pot must set firmly on the stand and the flame must be adjusted to maintain the lead in a molten state with a metallic blue tinge.

(1) Assembly
(2) Operating procedures

1j. Assemble and pour a horizontal joint, using training aids. Lead ring must be 3/4" to 1" in depth.

(1) Application of horizontal joints
(2) Equipment required
(3) Pouring procedures

1k. Using given procedures, construct a building drain in the booth area. Pipe must be graded 1/4 inch per foot.

(1) Material required
(2) Tool and equipment required
(3) Construction procedures

Course No: 3ABR55235
Day: 10 & 11

Branch Approval:
Date: 20 August 1975

PART II

INTRODUCTION (40 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hours 15 Minutes)

PRESENTATION:

1a. Given three pieces of plumbing materials, correctly identify each as to common names, size, material, and general application. All items must be correctly identified.

(1) Definition of a building drain: that part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building (house) sewer, beginning 5' outside the building wall

(2) Location

(a) Below floor

(b) Underground

(c) Suspended from floor joist

(d) Start at main soil and waste stack

(3) Type of material used

(a) Cast iron

1 Joints

- a Lead and oakum (caulked joint)
- b Compression
- c No - Hub

2 Weights of cast iron

- a Service weight
- b Extra heavy

3 Type hubs

- a Single hub
- b Double hub

4 Cast iron used under concrete

(b) Copper

1 Joints-soldered

2 Types-M & DWV.

(c) Plastic

1 Types

a ABS Acrylonitrile-Butadiene-Styrene

b PVC Polyvinyl Chloride

2 Forms

a Rigid-Screwed or solvent weld

b Semi-rigid-solvent weld

c Flexible-clamps

1b. Using given instructions and plumbing symbols, draw a diagram of a building drain. Diagram must be complete enough to make a bill of materials.

(1) Blueprints

(a) Floor plan

(b) Elevation plan

88

(c) Plot plan

    (d) Roof plan

    (e) Foundation plan

(2) Working drawings

    (a) Plan of installation

    (b) Materials required for job

    (c) Types

        1 Top

        2 Side

        3 Isometric

(3) Symbols and fittings

NOTE: Discuss those used in the drainage system

(4) Manufacturer's rough-in specifications

(5) Specifications sheets

    (a) Types

(b) Size

(c) Quality

(d) Quantity

(6) Codes

(a) National

(b) Local

(c) AFM 85-20

NOTE: Discuss layout of booth building drain

1c. Using a diagram of a building drain system, make a complete bill of materials. Bill of materials must contain the length and size of the pipe and the type and size of all fittings.

(1) Definition- a tubulated list of requirements for a job showing the name, description, quantity, stock number, size and cost

(a) Made up from working drawing or plans

(b) Stock numbers and cost required research from manufacturers' catalogs

(2) Take off items

- (a) Thread cutting oil
- (b) Joint compounds
- (c) Bolts, screws, nails, etc.

(3) Purpose

- (a) Requirements for a job
- (b) Estimate of job cost
- (c) Save time

1d. Using a measuring tape or rule, measure and mark pipe to within ± 1/8 inch of specific length

(1) Hub to spigot-from back of hub to spigot end

(2) Fittings

- (a) Back of hub to centerline
- (b) Centerline to the spigot end

1e. Cut cast iron pipe to a specified length ± 1/8 inch, using a cold chisel and hammer.

(1) Oldest method

(a) 4" pipe-1" cold chisel 16 oz. ball peen hammer

(b) 2" pipe- 3/4" cold chisel 16 oz. ball peen hammer

(c) Sound out pipe before and after cutting

(2) Safety precaution-wear gloves and goggles

1f. Cut cast iron pipe to a specified length ± 1/8 inch using a snap cutter.

(1) Sound out pipe

(a) Before cutting

(b) After cutting

(2) Safety

(a) Wear gloves

(b) Protect others in working area

41

1g. Using a hacksaw and adjustable jaw wrench, cut one half inch 1/8 inch from the end of a cast iron pipe.

(1) Used on cuts two inches or less from end of pipe

(2) Sound out pipe

(a) Before cutting

(b) After cutting

(3) Safety-avoid cutting hands

(4) Other methods

(a) Chain cutter

(b) Pipe cutter

(c) Hydraulic cutter

1h. Using given procedures, move and store propane gas containers. Containers must be stored and secured in accordance with given instructions.

(1) Moving

- (a) Cylinder valves closed and capped
- (b) Acetylene transferred vertically
- (c) Use hand truck when possible
- (d) Do not lift bottle by valve

(2) Storage

- (a) Acetylene stored in upright position
- (b) Secure cylinders
- (c) Mark empty cylinders and store separately
- (d) Cylinders of different gases stored separately
- (e) If stored close to each other, must have approved fire break
- (f) Protect against cold and heat

11. Using given procedures, assemble and operate a plumber's furnace. The lead pot must set firmly on the stand and the flame must be adjusted to maintain the lead in a molten state with a metallic blue tinge. 71

(1) Assembly

(a) Install orifice and tighten

(b) Put stand on and tighten

(c) Put on shield

(d) Set melting pot on

NOTE: Set up where there is little traffic and well ventilated.

(2) Operating procedures

(a) Blow out orifice using "T" handle

(b) Twist piece of paper and ignite

(c) Put on goggles and gloves

(d) Place flame at tip of orifice

(e) Open valve slowly using "T" handle

(f) Regulate flame

(g) Place ladle on pot

1j. Assemble and pour a horizontal joint, using training aids. Lead ring must be 3/4" to 1" in depth.

(1) Application of horizontal joints

(a) Soil and waste branch lines

(b) Building drains

(c) House sewers

(2) Equipment required

(a) Training aid

(b) Plumbers furnace

1 Propane tank

2 Orifice

3 "T" handle

4 Melting pot

5 Shield

6 Melting pot hook

(c) Asbestos gloves

(d) Face shield

(e) Asbestos joint hammer

(f) Ladle

(g) Yarning iron

(h) Packing iron

(i) 8oz and 16oz ball peen hammer

(j) Inside and outside caulking iron

(3) Pouring procedures

(a) Install asbestos joint runner

(b) Insert oakum where clamp holds ends of runner

(c) Check temperature of lead

1 Twisted paper

2 Thermometer

3 Bluish tinge color

(d) Shim off impurities

(e) Ladle full and shout "Hot lead"

(f) Carry lead to joint and fill to top of hub

(g) Again sound out "Hot lead" and return to furnace

(h) Place empty ladle back on furnace

APPLICATION:

Complete WB 3ABR55235-II-1-P1.

CONCLUSION (5 Minutes)

SUMMARY:

STUDY ASSIGNMENT: SG 3ABR55235-II-1

INTRODUCTION (40 Minutes, Day 11)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

OVERVIEW:

MOTIVATION:

BODY (5 Hours 15 Minutes)

PRESENTATION:

1k. Using given procedures, construct a building drain in the booth area. Pipe must be graded 1/4 inch per foot.

(1) Materials required

(a) Hub type cast iron soil pipe

(b) Hub type cast iron fittings

1 One hub type stack base with clean out plug

2 Two 4"x4"x2" combination wye and eight bends

(2) Tools and equipment required

(a) Plumber's furnace

1 Propane tank

2 Orifice

3 "T" handle

4 Melting pot

5 Shield

6 Melting pot hook

(b) Asbestos gloves

(c) Face shield

(d) Asbestos joint runner

(e) Ladle

(f) Yarning iron

(g) Packing iron

(h) 16oz and 8oz ball peen hammer

(i) Inside and outside caulking iron

(3) Construction procedures

(a) Cut cast iron pipe to correct length

(b) Align fittings and make joints

(c) Support stack base with concrete base

(d) Suspend building drain from floor joist using hanger iron

APPLICATION:

Complete WB 3ABR55235-II-1-P2.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: SG 3ABR55235-II-2

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/19Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste System

LESSON TITLE
Vents and Stacks (Days 12 and 13)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
12 Hrs	0	12 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
19	2 July 1975	2

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Plumber's Furnace Shop Tools Special Tools Safety Equipment	C.I. Fittings C.I. Pipe Oakum Lead		SG II-2 WB II-2-P1, P2, P3, P4 Rough in Specifications and Drawings Slides: Progression of Building Waste System

CRITERION OBJECTIVES AND TEACHING STEPS

2a. Given a drawing of a plumbing system, determine the type of vent and stack system used.

(1) Stacks
(2) Vents

2b. Following given instructions, make a working drawing of a plumbing vent system and name the fittings. Drawing must be complete.

(1) Location of fittings
(2) Type of materials
(3) Alignment of piping
(4) Use of roof flashings

ATC FORM AUG 73 770

LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

2c. Using your working drawing, select all the soil pipe and fittings required to construct a main vent stack in the booth area.

(1) Material required
(2) Measurement for height of sanitary tee, vent tee, and roof terminal

2d. Following given instructions and working as a member of a team, assemble a vent and stack system in the assigned booth area. Pipe must be aligned within ± 1/2 inch of given specifications.

(1) Alignment
(2) Support

Course No: 3ABR55235
Day: 12

Branch Approval:
Date: 19 August 1975

PART II

INTRODUCTION (40 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

54

BODY (5 Hours 15 Minutes)

PRESENTATION:

2a. Given a drawing of a plumbing system, determine the type of vent and stack system used.

(1) Stacks

(a) Soil stack or main stack

1 Vertical piping that carries human waste from water closets, uranals, and similar fixtures to a soil pipe or building drain

2 Size determined by the number of fixtures connected to it (fixture units)

(b) Waste stack

1 Vertical piping that carries waste from all fixtures is not designed to receive and discharge human waste

2 Size is determined by the number of fixtures connected to it

(c) Vent stack

1 Vertical piping which provides circulation of air to and from any part of the drainage system

(2) Vents

(a) Keeps drainage system at atmospheric pressure at all times

(b) Doesn't convey any type of soil or waste

(c) Type of vent depends on

1 Design of the building

2 Number of fixtures (fixture units)

3 Location or grouping of fixtures

(d) Main vent

1 Pipe runs parallel to soil or waste stack

2 Connects full size at base of stack with a wye below the lowest fixture

3 Extends through roof, or returns to stack above the highest fixture

4 Is a vent only NO waste or soil materials

(e) Individual vent

1 One trap connected to one vent

2 Can be connected to the main vent or stack above the fixture flood level

(f) Unit or dual vent

1 Two fixture traps connected to one common vent

2 Traps can be either side to side or back to back

(g) Circuit vent

1 Used on a battery of fixtures not to exceed eight

2 Vented between the first two fixtures (farthest), and between the last fixture closes to the soil or waste stack

3 Vent returns back to the main vent (vent stack)

(h) Loop vent

1 A vent for a battery of fixtures not to exceed eight

2 Vent is taken between the first two and last fixture and returns to the stack vent

(i) Stack vent-sometimes called waste or soil vent. It is the extension of a soil or waste stack above the highest horizontal drain and connects to the stack.

(j) Relief vent

1 Prevents syphonage and back pressure (additional venting)

2 Used on systems such as a horizontal drain, in circuits or loops, and in long stacks

(k) **Wet vent**

1 The portion of a pipe through which liquids flow from one fixture which is acting as a vent for another fixture

2 Very poor type of venting

3 Commonly found in residential bathroom fixture groupings, for the bathtub

(l) Purpose of venting system

1 Prevent trap seal loss

2 Provides for the circulation of air to assure an equal pressure through the system

(m) Trap seal loss

1 Direct syphonage

2 Indirect syphonage

3 Evaporation

4 Capillary attraction

2b. Following given instructions, make a working drawing of a plumbing vent system and name the fittings. Drawing must be complete.

(1) Location of fittings

(2) Types of materials

(3) Alignment of piping

(4) Use of roof flashing

2c. Using your working drawing, select all the soil pipe and fittings required to construct a main vent stack in the booth area.

(1) Materials required

(2) Measurement for height of sanitary tee, vent tee, and roof terminal

APPLICATION:

Complete WB 3ABR55235-II-2-P1

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Review todays notes.

Course No: 3ABR55235
Day: 13

PART II

INTRODUCTION (30 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

OVERVIEW:

MOTIVATION:

BODY (5 Hours 25 Minutes)

PRESENTATION:

2d. Following given instructions and working as a member of a team, assemble a vent and stack system in the assigned booth area. Pipe must be aligned within ± 1/2 inch of given specifications.

(1) Alignment

(a) Use of level

(b) Use of plumb bob.

(2) Supports

(a) Strap iron

(b) Hangers

(c) Stack base

APPLICATION:

Complete WB 3ABR55235-II-2-P1, P2, P3, and P4.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Complete SG 3ABR55235-II-3.

64

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/20Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste System

LESSON TITLE
Floor Drains and Roof Drains (Day 14)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
3 Hrs	1 Hr	4 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
21	2 July 1975	3

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 23 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
None	None	None	SG II-3 WB II-3-P1 Slides, Roof, Floor Drains

CRITERION OBJECTIVES AND TEACHING STEPS

3a. Given a sketch of a roof and floor drain system, make a bill of materials for the installation of a drain system. Bill of materials must contain the length, type and size of all pipe and the type and size of all fittings.

a. Purpose and location of roof and floor drain systems
b. Components of roof and floor drain systems
c. Codes governing roof and floor drain installation
d. Types of floor drain fittings
e. Types of traps
f. Floor preparation

ATC FORM AUG 72 770

Course No: 3ABR55235
Day: 14

Branch Approval:
Date: 20 August 1975

PART II

INTRODUCTION (40 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (2 Hours 15 Minutes)

PRESENTATION:

3a. Given a sketch of a roof and floor drain system, make a bill of materials for the installation of a drain system. Bill of materials must contain the length, type and size of all pipe and the type and size of all fittings.

(1) Roof drains

(a) Purpose-to collect and remove water from a roof to a point of disposal

(b) Location

1 Should be centrally located

2 Must be in the lowest portion of roof

3 Sun decks

4 Parking decks

5 Roof gardens

6 Area where traffic passes

(2) Floor drains

(a) Purpose-to remove waste water from a given area to a point of disposal

(b) Location-the floor drain should be located centrally to properly drain the floor area

1 Basements

2 Laundry rooms

3 Boiler rooms

4 Area that requires washing down

5 Battery of showers

6 New urinal

7 Wash racks

8 Warehouses

(3) Components of roof and floor drainssystems

68

(a) Interior systems

1 Piping concealed in the wall or inside the building

2 Must have water tight connections

3 Should be supported at each floor level

4 Swing joints are used to prevent breakage of connections and damage to the building

(b) Exterior system

1 Piping is exposed outside the building

2 The down spout must be water tight

3 The water flows to a splash plate or a storm drain

(c) Types of strainers

1 Flat strainers

100

    - a Sun decks
    - b Parking decks
    - c Roof gardens
    - d Area where traffic passes
- 2 Mushroom strainer
    - a Flat roofs
    - b Area where leaves or other debris may collect
    - c Area where there is little traffic
- 3 Sloped strainers
    - a Placed in corners
- 4 Floor drains
    - a Housing
    - b Seepage flange

(d) Codes governing roof and floor drain installation

1 AFM 85-20

2 National plumbing code

3 State code

4 Local code

(e) Types of floor drain fittings

1 Recessed

2 Drainage

3 Materials used

a Copper

b Plastic

c Cast iron

(f) Types of traps

1 Common seal trap (2")

2 Deep seal trap (4")

3 Trap with clean outs

(g) Floor preparation

1 Lead pan

2 Copper pan

3 Where they are installed

4 Installation procedures

APPLICATION:

Have students complete WB 3ABR55235-II-3-P1, Floor and Roof Drains.

72

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: NONE

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE B R Arrington TCETC/20Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste System

LESSON TITLE
Waste Rough-in for Lavatories (Day 14)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
3 Hrs	1 Hr	4 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
22	2 July 1975	4

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	C.I. Fittings Oakum Lead	None	SG II-4 WB II-4-P1 Slides: Progression of Building Waste System

CRITERION OBJECTIVES AND TEACHING STEPS

4a. Given the rough-in specifications for a lavatory, correctly answer four questions concerning the installation of lavatories.

(1) Rough-in specifications
(2) Type vents.

4b. Given a shop drawing of a lavatory drain system, determine the plumbing installation method required, and make a list of all the material needed to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excesses greater than 10%.

(1) Lavatory drains
(2) Identification of pipe and fittings used
(3) Assembly procedures

ATC FORM AUG 72 770

74

Course No: 3ABR55235
Day: 14

Branch Approval:
Date: 20 August 1975

PART II

INTRODUCTION (15 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (2 Hours 40 Minutes)

PRESENTATION:

4a. Given the rough-in specifications for a lavatory, correctly answer four questions concerning the installation of lavatories

   (1) Rough in specifications

      (a) Distance from finished floor to center of drain

      (b) Height of hanger bracket

   (2) Type vents

      (a) Individual vent

      (b) Individual back vent

4b. Given a shop drawing of a lavatory drain system, determine the plumbing installation method required, and make a list of all the material needed to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excesses greater than 10%.

   (1) Location of drains

- (a) Normally drains into the soil or waste stack
- (b) May be located in the blueprints on the floor plan
- (c) Height will be taken from the manufacturer's rough-in
- (d) Minimum size is 1 1/4" drain

(2) Types of piping used

- (a) Cast iron
  - 1 Service
  - 2 Extra heavy
- (b) Copper
  - 1 D.W.V. (yellow)
  - 2 K. (green)
  - 3 L. (blue)

4 M. (red)

(c) Galvanized

(d) Plastic

1 ABS-DWV

2 PVC-DWV

(3) Types of fittings used

(a) Cast iron

(b) Drainage (recessed) fittings

(c) Copper

(d) Plastic

(4) Assembly procedures

(a) Cast iron

78

1 Caulked

2 Clamped

3 Seals

(b) Copper (sweated)

(c) Galvanized (screwed)

(d) Plastic

1 Screwed

2 Solvent weld

APPLICATION: Have the students install the lavatory drain and accomplish WB 3ABR55235-II-4-P1.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Read SG 3ABR55235-II-5, Installation of Back Vents and answer the questions at the end of the text.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE: B R Arrington TCETC/19Aug75

INSTRUCTOR:

COURSE NUMBER: 3ABR55235

COURSE TITLE: Plumbing Specialist

BLOCK NUMBER: II

BLOCK TITLE: Building Waste Systems

LESSON TITLE: Installation of Back Vents (Day 15)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
6 Hrs	2 Hrs	8 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
23	2 July 1975	5

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Plumber's Furnace Shop Tools	Galvanized Pipe Drainage Fittings	None	SG II-5 WB II-5-P1 Specification and Drawings Slides: Progression of Building Waste System

CRITERION OBJECTIVES AND TEACHING STEPS

5a. Using shop drawings of a back vent system, make a list of all of the materials required to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.

(1) Working drawings
(2) Bill of materials

5b. Using either a hand-operated pipe cutter or hacksaw, cut steel pipe to a given length ± 1/8 inch.

(1) Measurement of steel pipe
(2) Methods of cutting steel pipe

ATC FORM AUG 72 770

81

LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

5c. Using either a reamer or a suitable file, dress a pipe end. All burrs must be removed and the inner surface of the pipe must be returned to its original diameter.

(1) Methods of reaming
(2) Purpose of reaming

5d. Using a hand stock and die set, thread a piece of steel pipe. Three threads must extend beyond the face of the die segment.

(1) Types of threaders
(2) Threading by hand

5e. Assemble threaded pipe and fittings. Completed joint must be water tight.

(1) Assembly procedures
(2) Use of pipe wrenches
(3) Fittings

Course No: 3ABR55235
Day: 15

Branch Approval:
Date: 19 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT:

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hours)

PRESENTATION:

5a. Using shop drawings of a back vent system, make a list of all of the materials required to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.

(1) Working drawings

(a) Top view

(b) Side view

(c) Isometric

(2) Bill of materials

(a) Tabulated list

(b) Take off items

5b. Using either a hand-operated pipe cutter or hacksaw, cut steel pipe to a given length ± 1/8 inch.

(1) Measuring steel pipe

(a) End-to-end

(b) End-to-center

(c) Center-to-center

(2) Methods of cutting steel pipe

(a) Hand pipe cutter; one, two, or three wheel.

(b) Hacksaw

(c) Power cutter

5c. Using either a reamer or a suitable file, dress a pipe end. All burrs must be removed and the inner surface of the pipe must be returned to its orginal diameter.

(1) Methods of reaming

(a) Hand reamer

(b) Half round file

(c) Quarter round file

(d) Rat-tail file

(2) Purpose of reaming

(a) Reduce friction

(b) Restore the inside pipe diameter

5a. Using a hand stock and die set, thread a piece of steel pipe. Three threads must extend beyond the face of the die segment.

(1) Types of threaders

(a) Hand stock and die set

(b) Power threader

(c) Geared threader

(d) Adjustable hand threader

(e) Non-adjustable hand threader

(2) Threader by hand

(a) Non-adjustable 1/8 inch to 2 inch

(b) Adjustable 1 inch to 2 inch

(c) Proper thread length

5e. Assemble threaded pipe and fittings. Completed joint must be water tight.

(1) Assembly procedures

(a) Apply pipe dope to male threads only

(b) Leave approximately 3 threads when assembling

(2) Use of pipe wrenches

(3) Fittings

(a) Drainage/recessed

(b) Tucker

APPLICATION:

Have students complete WB 3ABR55235-II-5-P1, Project 1, 2, and WB 3ABR55235-II-5-P2

EVALUATION:

Evaluate by oral, written instructions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (15 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Read SG 3ABR55235-II-6 and complete questions at end of chapter.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/19Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste Systems

LESSON TITLE
Rough-in for Urinal Drains (Day 16)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
6 Hrs	2 Hrs	8 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
24	2 July 1975	6

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools Plumber's Furnace	No Hub Clamps Cast Iron Pipe Cast Iron Fittings	None	SG II-6 WB II-6-P1 Rough-in Specifications and Drawings Slides: Progression of Building Waste System

CRITERION OBJECTIVES AND TEACHING STEPS

6a. Given an illustration of three types of urinal vents, correctly name each type.

(1) Types of urinals
(2) Flushing actions
(3) Types of vents

6b. Using a working drawing, make a bill of materials for the construction of a urinal vent and drain system. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.

(1) Identification of materials
(2) Types of joints
(3) Symbols used

ATC FORM AUG 72 770

LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

6c. Following the prescribed procedures and working as a member of a team, install a urinal waste and vent system in the booth area. The drainage tee must be within 1/4 inch of the center of the existing hole.

(1) Methods of assembly
(2) Safety

90

Course No: 3ABR55235
Day 16

Branch Approved: Robert B. Hayes III
Date: 19 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hours)

PRESENTATION:

6a. Given an illustration of three types of urinal vents, correctly name each type.

(1) Types of urinals

(a) Wall-hung

(b) Pedestal

(c) Trough

(d) Stall

(2) Flushing actions

(a) Washdown

(b) Siphon-jet

(3) Types of vents

(a) Dual

(b) Back

(c) Circuit

(d) Individual

6b. Using a working drawing, make a bill of materials for the construction of a urinal vent and drain system. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.

(1) Identification of materials

(a) Cast iron-usually used on urinal drains

(b) Copper

(c) Plastic

(d) Galvanized

(2) Types of joints

(a) Caulked

(b) Flanged

(c) Welded

(d) Screwed

(e) Soldered

(3) Symbols used

(a) Caulked

(b) Flanged

(c) Welded

(d) Screwed

(e) Soldered

6c. Following the prescribed procedures and working as a team member of a team, install a urinal waste and vent system in the booth area. The drainage tee must be within 1/4 inch of the center of the existing hole.

(1) Methods of assembly

(2) Safety

(a) Exercise caution when working with lead

(b) Wear protective devices

APPLICATION:

Have students complete WB 3ABR55235-II-6-P1 and P2 in their study guides.

EVALUATION:

Evaluate by oral or written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (15 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT:

Read SG 3ABR55235-II-7 and answer all questions at the end of the chapter.

96

LESSON PLAN (Part I, General)

APPROVAL OFFICE TCETC/19Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste Systems

LESSON TITLE
Rough-in for Shower and Tub Drains (Day 17)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
6 Hrs	2 Hrs	8 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
25	2 July 1975	7

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	Cast Iron Pipe Oakum Lead Cast Iron Fittings	None	SG II-7 WB II-7-P1 Rough-in Specifications Slides: Bathtub

CRITERION OBJECTIVES AND TEACHING STEPS

7a. Using the illustrations provided, identify the components of a shower and tub drain system. All eight items must be identified correctly.

(1) Types of bath tubs and construction features
(2) Types of showers and construction features

7b. Following the prescribed procedures and working as a member of a team, install a shower drain system in the booth area. The shower strainer must be within 1/4 inch of the center of the existing hole.

(1) Pipe supports
(2) Booth design

ATC FORM AUG 72 770

97

Course No: 3ABR55235
Da: 17

Branch Approval:
Date: 19 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hours 5 Minutes)

PRESENTATION:

7a. Using the illustrations provided, identify the components of a shower and tub drain system. All eight items must be identified correctly.

(1) Types of bath tubs and construction features

(a) Recessed

1 Right hand

2 Left hand

(b) Corner

1 Right hand

2 Left hand

(c) Construction features

1 Minimum size drain 1 1/2"

2 Minimum size with shower combination 1 1/2"

3 Tub overflow and drain attachment

4 Trap is included in rough-in

5 Can use drum or P-trap-installed when roughing in drain

6 Use plastic, cast iron or copper on drain or vent

7 Use of slip joints

a In trap seal

b Inlet of trap

(2) Types of showers and construction features

(a) Types

1 Recessed

2 Metal cabinet

3 Tub and shower combination

4 Gang showers

(b) Construction features

1 Minimum size drain 2"

2 Use CI P-trap

3 Use CI under concrete

4 Construct base with lead or copper pan

a Minimum 6" bend on each side

b Not required if built at ground level on concrete

5 Types of vents

7b. Following the prescribed procedures and working as a member of a team, install a shower drain system in the booth area. The shower strainer must be within 1/4 inch of the center of the existing hole.

(1) Pipe supports

  (a) Vertically-every floor level

  (b) Horizontally

    1 Every 5 feet on CI

    2 Every 10 feet on galvanized.

(2) Booth design

  (a) Center plumbob in shower drain opening

  (b) Measure from plumbob to 2" combo

  (c) Deduct from "P" trap

  (d) Cut and "P" trap and 2" CI pipe

  (e) Determine length of riser to shower drain

  (f) Cut and install riser and shower drain

APPLICATION:

Complete Mission I and II of WB 3ABR55235-II-7-P1.

EVALUATION:

Evaluate by oral or written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (10 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Read SG 3ABR55235-II-8 and answer questions at end of chapter.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/19Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste Systems

LESSON TITLE

Rough-in for Water Closet Drains (Day 18)

LESSON DURATION

CLASSROOM/LABORATORY 6 Hrs	COMPLEMENTARY 2 Hrs	TOTAL 8 Hrs

POI REFERENCE

PAGE NUMBER 26	PAGE DATE 2 July 1975	PARAGRAPH 8

STS/CTS REFERENCE

NUMBER 552X5	DATE 15 February 1973, Chg 1, 25 February 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	Cast Iron Pipe Cast Iron Fittings	None	SG II-8 WB II-8-P1 Slides: Water Closet Rough-in

CRITERION OBJECTIVES AND TEACHING STEPS

8a. Given a sketch of a single water closet installation, locate and name each component in the vent and drain system. All nine items must be identified correctly.

(1) Types of water closets
(2) Flushing mechanisms

8b. Given a sketch of a vent and drain system for a water closet, make a bill of materials and select the necessary pipe and fittings to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.

(1) Design of systems
(2) Materials for booth

ATC FORM AUG 73 770

LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

8c. Working as a member of a team and following given instructions, construct a vent and drain system for a water closet. All measurements must be within ± 1/4 inch of given specifications.

(1) Use of working drawing
(2) Booth construction

Course No: 3ABR55235
Day: 18

Branch Approval: Robert B [illegible]
Date: 19 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hours 6 Minutes)

PRESENTATION:

8a. Given a sketch of a single water closet installation, locate and name each component in the vent and drain system. All nine items must be identified correctly.

(1) Types of water closets

(a) Floor-mounted- mounted on floor flange

(b) Wall-mounted- mounted with chair carrier

(2) Flushing mechanisms

(a) Tank

(b) Flushometer

1 Piston type

2 Diaphragm type

8b. Given a sketch of a vent and drain system for a water closet, make a bill of materials and select the necessary pipe and fittings to construct the system in the booth area. The list of materials must accurately identify all required materials without shortages and without excess greater than 10%.

(1) Design of systems

- (a) Analyzing for materials
- (b) Selecting materials

(2) Materials for booth

- (a) 4" sanitary tee
- (b) 4" cast iron pipe
- (c) 4" closet bend
- (d) 4" closet flange
- (e) Lead and oakum
- (f) Clamps

8c. Working as a member of a team and following given instructions, construct a vent and drain system for a water closet. All measurements must be within ± 1/4 inch of given specifications.

(1) Use of working drawing

(a) Locate exact fixture placement

(b) Center pipe in openings

(2) Booth construction

(a) Measure and cut pipe to desired length

(b) Assemble pipe in booth area

APPLICATION:

Complete WB 3ABR55235-II-8-P1.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (10 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Read and answer questions in SG 3ABR55235-II-9.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/21Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER II	BLOCK TITLE Building Waste Systems

LESSON TITLE
Testing Drainage Systems (Day 19)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
4 Hrs	2 Hrs	6 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
28	2 July 1975	9

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	None	None	SG II-9 WB II-9-P1 Shop Drawings Slides: Testing Water Systems

CRITERION OBJECTIVES AND TEACHING STEPS

9a. Given the necessary tools and equipment and working as a member of a team, perform a water leak test on a newly constructed waste system. Locate all leaks.

(1) Test equipment
(2) Procedures for testing

9b. Using the tools and material provided, repair one of each type leak located.

(1) Repair procedures
(2) Replacement procedures

ATC FORM AUG 72 770

Course No: 3ABR55235
Day: 19

Branch Approval:
Date: 21 August 1975

PART II

INTRODUCTION (40 Minutes)

CHECK PREVIOUS DAY'S STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (3 Hours 15 Minutes)

PRESENTATION:

9a. Given the necessary tools and equipment and working as a member of a team, perform a water leak test on a newly constructed waste system. Locate all leaks.

- (1) Test equipment
    - (a) Test plug with wing nut
    - (b) Test plug with ratchet
    - (c) Caps and plugs
    - (d) Other equipment depends on type of test
        - 1 Water test
            - a Water hose
            - b Stand pipe (possibly)
        - 2 Air test
            - a Air pump
            - b Gage

c Liquid soap

3 Smoke test

a Air pump

b Smoke machine

c Pressure gage

4 Peppermint test

a Hot water

b Peppermint

(2) Procedures for testing

(a) Water test

1 Most common

2 Easiest to perform

3 No more than five stories

4 Don't use in below freezing temperatures

5 Procedures

a Plug all openings except highest vent

b Fill system

c Let stand 12 to 24 hours

d Refill system

e Must not drop more than 4" in 30 Minutes

(b) Air test

1 Can be used in freezing temperature

2 Uniform pressure throughout system

3 Procedures

a Plug all openings

b Pressurize system-5 p.s.i. or column of mercury on mercury gage

c If pressure drops in first 15 minutes, there is a leak d To locate leak use soapy water in warm weather

e In freezing weather use linseed oil

(c) Smoke test

1 Use on old or modified work

2 Can be used as a final test

3 Procedures

a Plug all openings

b Light oily rags in smoke machine

c Assure all traps have water

d Force smoke into system

e Maintain 1/2 lb pressure system

f Bring inspector to job site to check for leaks g Leaks located by sight and smell

(d) Peppermint test

1 Use on old or modified work and as a final test

2 Procedures

a Plug all openings except main vent

b Traps must be sealed with water

c Pour two oz peppermint into each vent terminal

d Add five gallons hot water into each stack terminal

e Close vent terminals

f Bring inspector to check for leaks

g Good for five stories

h For each additional 5 stories add 1 oz more peppermint

9b. Using the tools and material provided, repair one of each type leak located.

- (1) Repair procedures
  - (a) Caulked joints
    - 1 Try recaulking
    - 2 Re-do joint
      - a Melt joint
      - b Pick out iron
      - c Use aission joint to make final connection
  - (b) No hub joints
    - 1 Tighten clamp
    - 2 Recheck joint
      - a Loosen clamp
      - b Check gasket for cuts

(c) Threaded joints

1 Cut pipe

2 Tighten joint

3 Use tucker fitting to re-connect pipe ends

(2) Replacement procedures

(a) Cut out damaged pipe

(b) Measure pipe allowing for sissions or tucker fittings

(c) Repair joint

APPLICATION:

Have students complete WB 3ABR55235-II-9-P1.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Prepare for block test: issue block III study guides and have students read and answer questions on SG 3ABR55235-III-1 and III-2.

3-22 120

SG 3ABR55235-II-1 thru 9

Department of Civil Engineering Training

Plumbing Specialist

BUILDING WASTE SYSTEMS

2 December 1974

SHEPPARD AIR FORCE BASE

Designed For ATC Course Use

DO NOT USE ON THE JOB

TABLE OF CONTENTS

PLUMBING SPECIALIST
Block II

PROJECT	TITLE	PAGE
3ABR55235-II-		
1	Building Drains	1
2	Vents and Stacks	21
3	Floor Drains and Roof Drains	31
4	Waste Rough-In for Lavatories	39
5	Installation of Back Vent	42
6	Rough-In for Urinal Drains	52
7	Rough-In for Showers and Tub Drains	57
8	Rough-In for Water Closet Drains	65
9	Testing Drainage Systems	71

This supersedes SG 3ABR55235-II-1 thru 9, 27 June 1973 (Copies of the superseded publication may be used until the supply is exhausted.)

Department of Civil Engineering Training
Sheppard Air Force Base, Texas

SG 3ABR55235-II-1
2 December 1974

BUILDING DRAINS

OBJECTIVE

Upon completing this unit of instruction, you will be able to identify a building drain system, the methods of cutting cast-iron pipe, the assembly of the building drainage system and safety precautions during the assembly process.

INTRODUCTION

The building drain is that part of the lowest piping of a drainage system which receives the discharge of all soil and waste and other drainage pipes inside the walls of the building and conveys it to the building (house) sewer, beginning five feet outside of the building wall. Careful planning during layout of the building drain and the location of fittings for soil and waste lines is necessary. This will insure that other parts of the drainage system can be connected to the building drain without rework or modification.

IDENTIFICATION OF BUILDING DRAIN

The building drain is also referred to as the house drain. It is located below floors, underground, or suspended from floor joists (see figure 1).

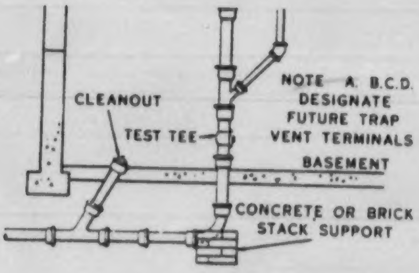

CLEANOUT
TEST TEE
NOTE A. B.C.D. DESIGNATE FUTURE TRAP VENT TERMINALS
BASEMENT
CONCRETE OR BRICK STACK SUPPORT

Figure 1. Building Drain

IDENTIFICATION OF TYPES OF PIPE

Cast-Iron Soil Pipe

Cast-iron soil pipe is one type of piping that can be used for sanitary drainage pipe and stacks in waste disposal systems. The types of joints that are made with cast-iron soil pipe are bell and spigot using lead and oakum, bell and spigot using a compression gasket, and no-hub pipe which is connected using a rubber seal and a stainless steel clamp (see figure 2).

123

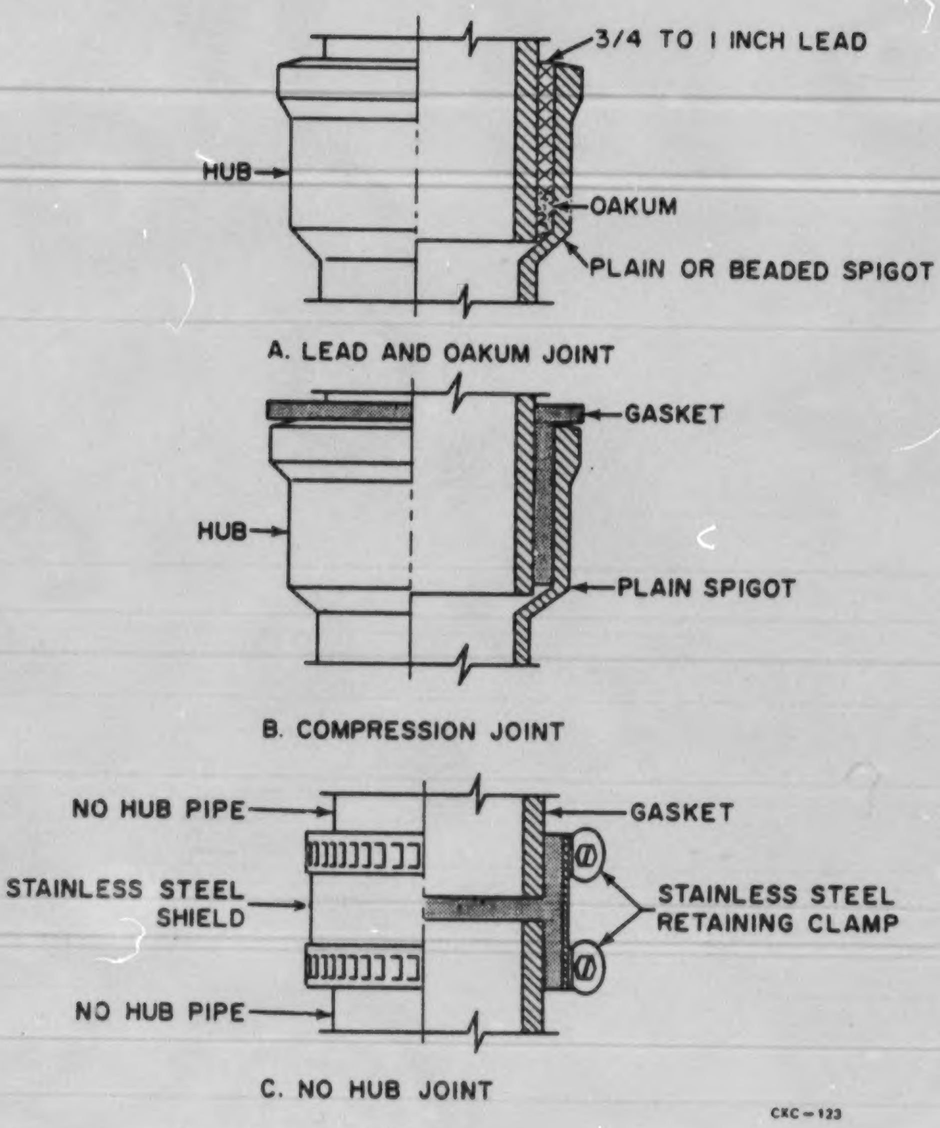

3/4 TO I INCH LEAD
HUB
OAKUM
PLAIN OR BEADED SPIGOT
A. LEAD AND OAKUM JOINT
GASKET
HUB
PLAIN SPIGOT
B. COMPRESSION JOINT
NO HUB PIPE
GASKET
STAINLESS STEEL SHIELD
STAINLESS STEEL RETAINING CLAMP
NO HUB PIPE
C. NO HUB JOINT
CKC-123

Figure 2. Joints Used to Connect Cast-Iron Soil Pipe and Fittings

There are two different thicknesses of cast or iron pipe--service weight and extra heavy. The selection of the weight of pipe to be used will be determined by the specific job.

Lengths of cast-iron pipe could have a hub on both ends. Double hub is convenient and economical since two short lengths of pipe can often be cut from one double-hub length instead of cutting these from two regular lengths (see figure 3).

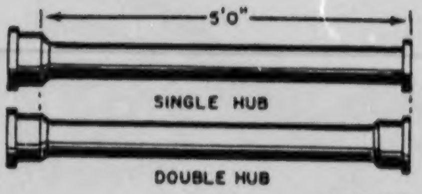


Figure 3. Cast-Iron Soil Pipe

Copper Tubing

Copper tubing has many advantages over cast-iron pipe. It is easier to transport and install and is more resistant to corrosion. Copper tubing is classified by its wall thickness and hardness. It is available in four wall thicknesses, type K, L, M, and DWV. Type K is the heaviest and most durable. Type L has a slightly thinner wall. Both are available in either hard (cold drawn) or soft (annealed) tubes. Types M and DWV are available only in hard temper. Types M and DWV are the only types of copper used in drainage lines and vents.

Hard copper tubing cannot be bent without annealing. When a change in direction is required, a fitting such as an elbow should be used. These joints in the waste system are soldered.

Plastic Pipe

Plastic pipe is extremely light weight, and very few tools are necessary for assembly. It is rust-, rot- and corrosionproof. It can be cut with a tubing or pipe cutter, saw, or a knife. Some of the plastic is designed to convey liquids intended for human consumption.

The pipe comes in three forms--rigid, semirigid, and flexible. The flexible comes in coils like copper tubing, and the rigid and semirigid come in 10, 15, or 20-foot lengths. Rigid is the only form of plastic used for drainage lines. This type of plastic is ABS-DWV (Acrylenitrile Butadiene - styrene) or PVC-DWV (Polyvinyl chloride). The pipe used for drains and vents can be joined by two methods--screwed, or solvent weld.

BLUEPRINTS AND DRAWINGS

Blueprints

Blueprints are drawn to scale and contain the information for various tradesmen to accomplish their specific jobs. A complete set contains floor plan, elevation plan, plot plan, roof plan, and foundation plan. The architect draws on these plans how the various systems are to be installed. If he doesn't, it is up to the individual tradesman to make what is called a working drawing. This is a plan of installation, and will aid the plumber in figuring the materials required for the job. The three views of working drawings are top, side, and isometric.

In order to read blueprints and make a working drawing, a plumber must be able to recognize symbols and draw them. Conventional plumbing symbols used on drawings are represented by figures 4, 5, and 6.

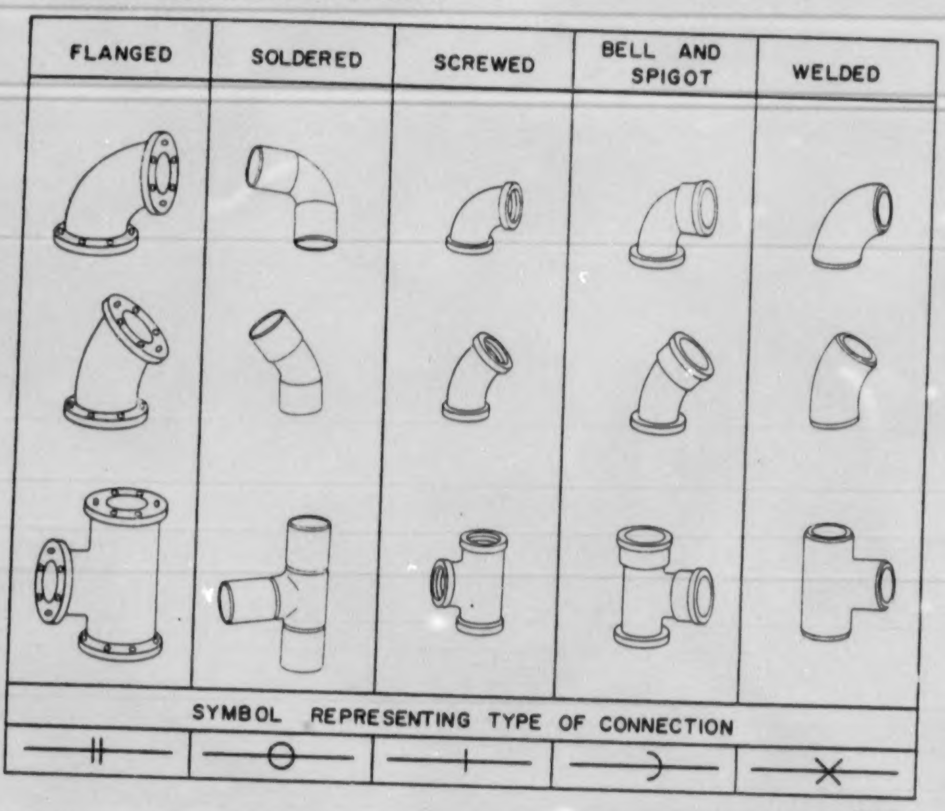

FLANGED
SOLDERED
SCREWED
BELL AND SPIGOT
WELDED
SYMBOL REPRESENTING TYPE OF CONNECTION
CHC-118

Figure 4. Symbols for Types of Connections

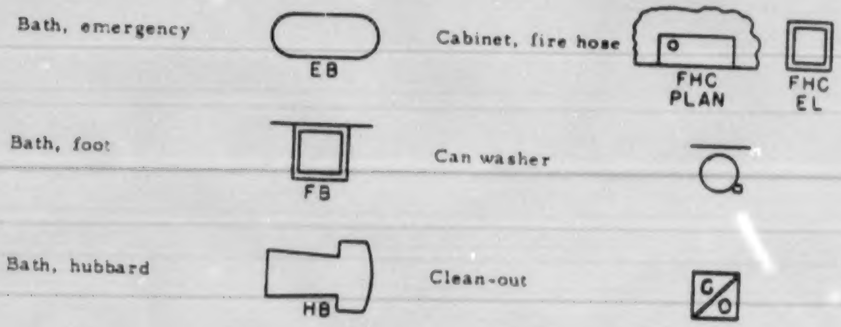

Bath, emergency
EB
Cabinet, fire hose
FHC PLAN
FHC EL
Bath, foot
FB
Can washer
Bath, hubbard
HB
Clean-out
C/O

Figure 5. Symbols for Fixtures

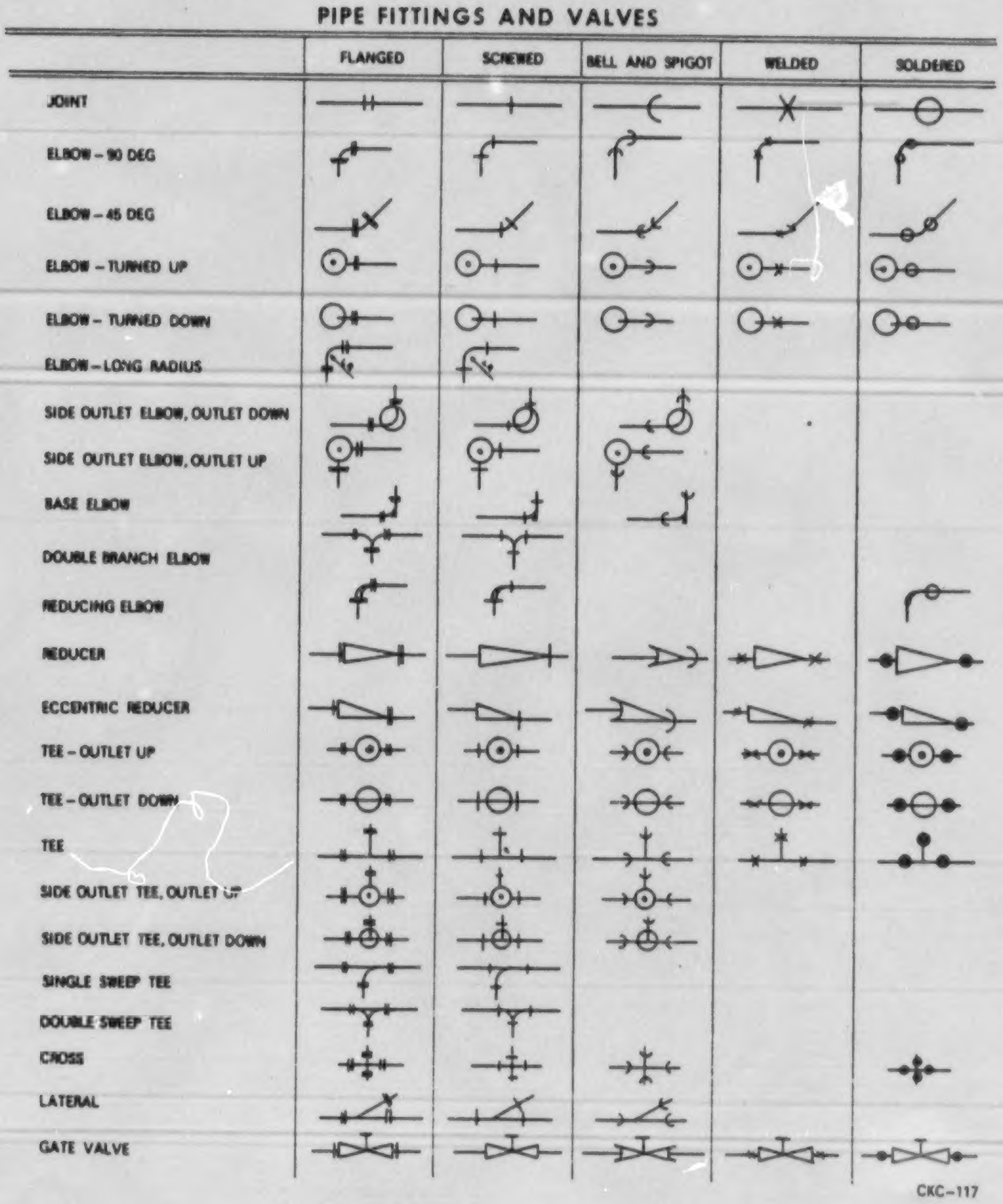

PIPE FITTINGS AND VALVES
FLANGED
SCREWED
BELL AND SPIGOT
WELDED
SOLDERED
JOINT
ELBOW – 90 DEG
ELBOW – 45 DEG
ELBOW – TURNED UP
ELBOW – TURNED DOWN
ELBOW – LONG RADIUS
SIDE OUTLET ELBOW, OUTLET DOWN
SIDE OUTLET ELBOW, OUTLET UP
BASE ELBOW
DOUBLE BRANCH ELBOW
REDUCING ELBOW
REDUCER
ECCENTRIC REDUCER
TEE – OUTLET UP
TEE – OUTLET DOWN
TEE
SIDE OUTLET TEE, OUTLET UP
SIDE OUTLET TEE, OUTLET DOWN
SINGLE SWEEP TEE
DOUBLE SWEEP TEE
CROSS
LATERAL
GATE VALVE
CKC-117

Figure 6. Plumbing Symbols for Piping and Pipe Fittings

Specification Sheets

Specification sheets are prepared which indicate the type and quality of material to be used in construction. The plumber and other tradesmen will use the blueprints and specifications to layout and plan their part of the project, see figure 7.

SPECIFICATIONS
FOR
PLUMBING
University of Nebraska
Lincoln, Nebr.

GENERAL CONDITIONS: The general arrangement of the plumbing shall be as indicated on the drawings. Detailed drawings of the proposed departures due to actual field conditions or other causes shall be submitted for approval. The contractor shall carefully examine the drawings and shall be responsible for the proper fitting of materials and equipment in each building as indicated, without substantial alteration.

UTILITIES: Water and drainage piping shall be extended to points 5 feet outside the building where the pipes shall be capped or plugged and left ready for future connections by others. Utilities shall be installed below the frostline. If trenches are closed or the pipes are otherwise covered before being connected to the street mains, the location of the end of each plumbing utility shall be marked with a stake.

Figure 7. Specification Sheet (Sample)

Manufacturer's Rough-in Specifications

Each manufacturer of fixtures publishes a catalog of rough-in measurements for their fixtures. These measurements are difficult to indicate on drawings, but they must be known for proper rough-in and installation of the fixtures. They include information such as dimensions of the fixture, location and size for rough-in of the water supply and drain, height of fixture from the floor and its hanger, and other pertinent information about the fixture, see figure 8.

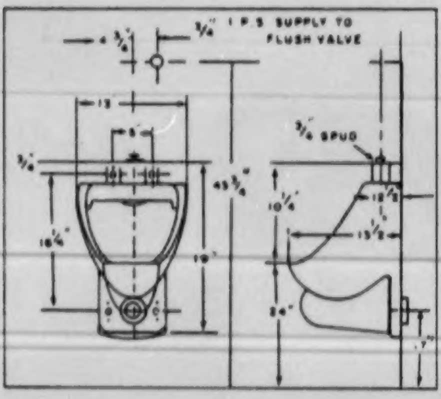


Figure 8. Rough-in Specification Sheet for Wall Hung Urinal

Codes

Plumbing systems at Air Force installations are installed and maintained in accordance with Air Force Manual 85-20 and the National Plumbing Code. Where there is a conflict between the two, AFM 85-20 will take precedence. Local codes are used throughout the nation to ensure a plumbing system is installed so it will function properly.

Bill of Materials

A bill of materials is a tabulated list of requirements for a job showing the name, description, quantity, stock number, size and sometimes the cost of the different items. Figure 9 shows a sample bill of materials. Quantities are taken from the plans or drawing by listing one item at a time, starting with the smallest size and progressing to the largest.

When special type valves or fittings are required for a certain job, the item should be located in a commercial manual. The manufacturer's number and type should be shown to insure positive identification.

A bill of materials in which the cost must be listed will require that each item be researched in manufacturers' catalogs to obtain the unit cost.

A list of so-called "takeoff" items should also be included in the bill of materials. These are items which are known to be necessary to complete the job but are not included on the prints or drawings. They include such items as thread cutting oil, joint compounds, and bolts or screws for attaching brackets.

ITEM	DESCRIPTION	PART NO.	QUANTITY	SIZE	COST
1	Valve, Gate-Brass with Wedge Disc, 100 Pound Pressure	Crane 410 or Equal	6	3/4"	4.10 each
2	Valve, Gate-Brass with Wedge Disc, 100 Pound Pressure	Crane 410 or Equal	2	1 1/4"	6.60 each
3	Valve, Globe-Brass with Composition Disc 150 Pounds Water Pressure at 200° F.	Crane 1250 or Equal	3	3/4"	3.40 each
4	Coupling, Pipe Reducer, Galvanized, 125 Pound Pressure	FSN 4730-277-2774	12	3/4" x 1/2"	11 each

Figure 9 Sample Bill of Materials

MEASURING AND MARKING PIPE

Measuring Cast-Iron Pipe

In order to measure cast-iron pipe accurately, it is important to learn how to locate the centers of the fittings. The center is that point where the lines flowing through the fitting intersects (figure 10).

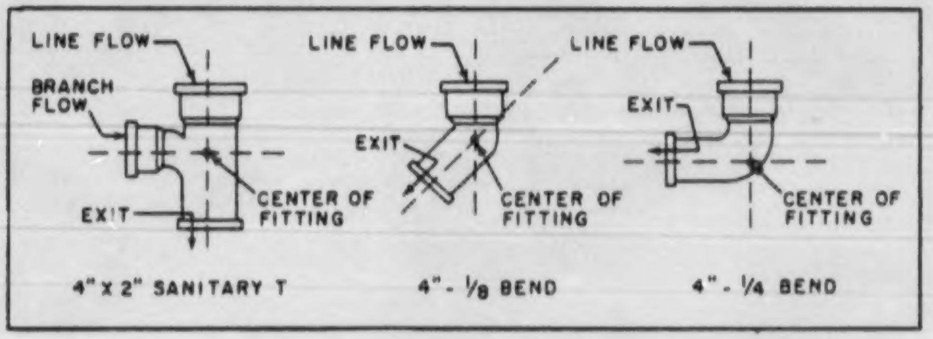

LINE FLOW
BRANCH FLOW
EXIT
CENTER OF FITTING
4" x 2" SANITARY T
LINE FLOW
EXIT
CENTER OF FITTING
4" - 1/8 BEND
LINE FLOW
EXIT
CENTER OF FITTING
4" - 1/4 BEND

Figure 10. Center Measurement for Cast-Iron Fittings

If the center-to-center measurement (center point of one fitting to center point of a second fitting) is required to be 36",then the length of the pipe connecting the fittings can be determined.

First, measure the distance from the centerpoint to the bottom of the hubs of one fitting. Also, measure distance from the center of the other fitting to the edge of the spigot.

Secondly, subtract the sum of the measurement from the original center to center measurement. The result will be the actual pipe length required for a 36" center-to-center installation.

Thirdly, measure the pipe length from the bottom of the hub to the length obtained in computations in the second step shown in figure 11.

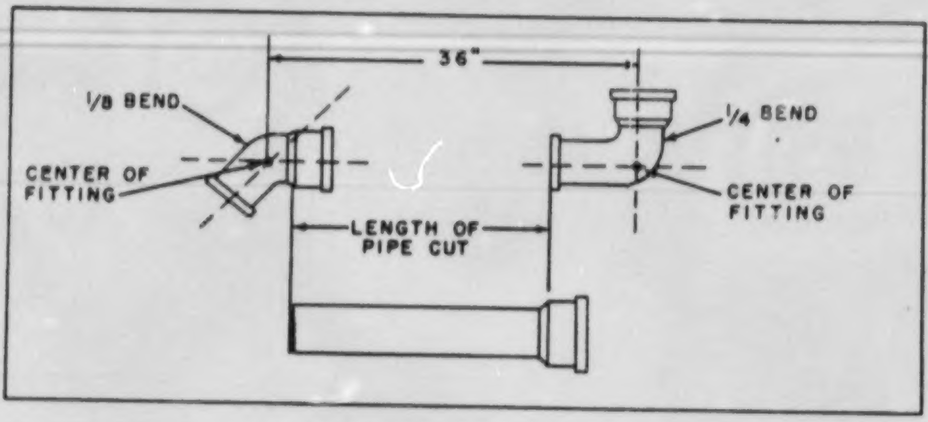
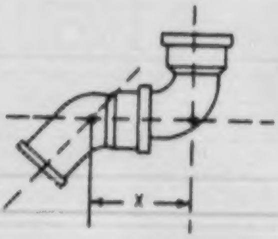


Figure 11. Determining Length of Pipe Cut

If it is possible to place the two fittings together, as shown in figure 12, the measurement between the center marks on the fittings can then be subtracted from the overall measurement of 36 inches to arrive at the length of pipe required. A fast method for determining pipe length is to let a rule do your figuring. Place the 36-inch mark of the rule on the center mark of the fitting on the right, as shown in figure 13. The mark on the rule which falls over the center mark of the fitting on the left then indicates the length to cut the pipe.

Each manufacturer of pipe and fittings supplies a catalog for convenience in ordering. Descriptions include dimensions of the many fittings manufactured by the company.



NOTE-SUBTRACT MEASUREMENT AT X FROM CENTER TO CENTER MEASUREMENT TO FIND LENGTH OF THE CUT

Figure 12. Using the Subtraction Method to Compute Pipe Length

/31

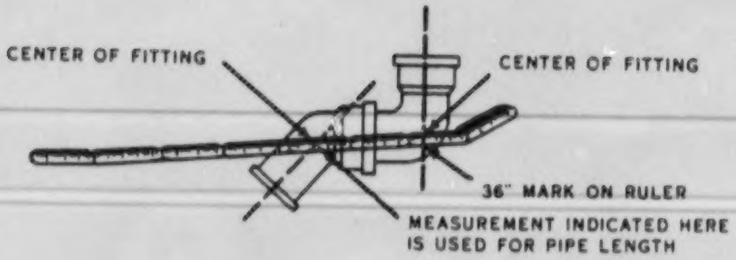


Figure 13. Using a Rule to Compute the Pipe Length

CUTTING CAST IRON

Methods

There are several methods of cutting cast-iron pipe. The oldest method is to use a cold chisel and a hammer. Before cutting the pipe, sound it out. This is accomplished by raising the pipe clear of the supports and striking it lightly with a hammer. A clear bell-like ring indicates that the pipe is not cracked and may be used. If the pipe has a dull sound, it is cracked and should be placed in a scrap barrel or a pile for salvage.

After sounding out the pipe, make a mark entirely around the pipe where the cut is to be made. When working inside or on a floor, use two blocks of wood, preferably 2 by 6 inches. One block of wood should be placed directly under the line of cut as shown in figure 14. The other block of wood should be placed near the end of the pipe, and so positioned to help support the pipe.

When you are working outside, you can use a mound of dirt instead of the wood blocks.

When cutting 4-inch pipe use a 1-inch cold chisel and a 16-ounce ball peen hammer. When cutting 2-inch cast-iron use a 3/4-inch cold chisel and a 16-ounce ball peen hammer. The taps should be light at first to score the pipe and gradually increase as the pipe is rotated. Keep the chisel in a vertical position when cutting. Continue to rotate the pipe and strike the cold chisel until the pipe breaks and separates.

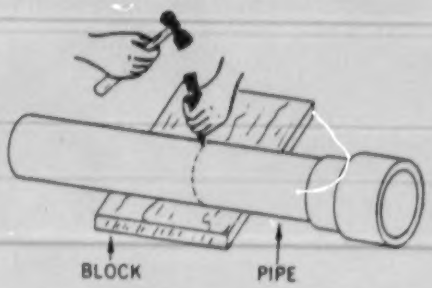


Figure 14. Cutting Cast-Iron Pipe With a Hammer and Chisel

When cutting cast iron with a hammer and chisel, it is necessary to wear goggles, gloves, and long sleeves because small chips of metal may penetrate the skin.

After the pipe has been cut, again sound it out to make sure you did not crack it while cutting.

There are other methods used to cut cast-iron pipe. The pipe can be cut with a snap cutter, chain cutter, pipe cutter, and a hacksaw and adjustable wrench. Some of these cutters are illustrated in figures 15, 16, 17, 18, 19.

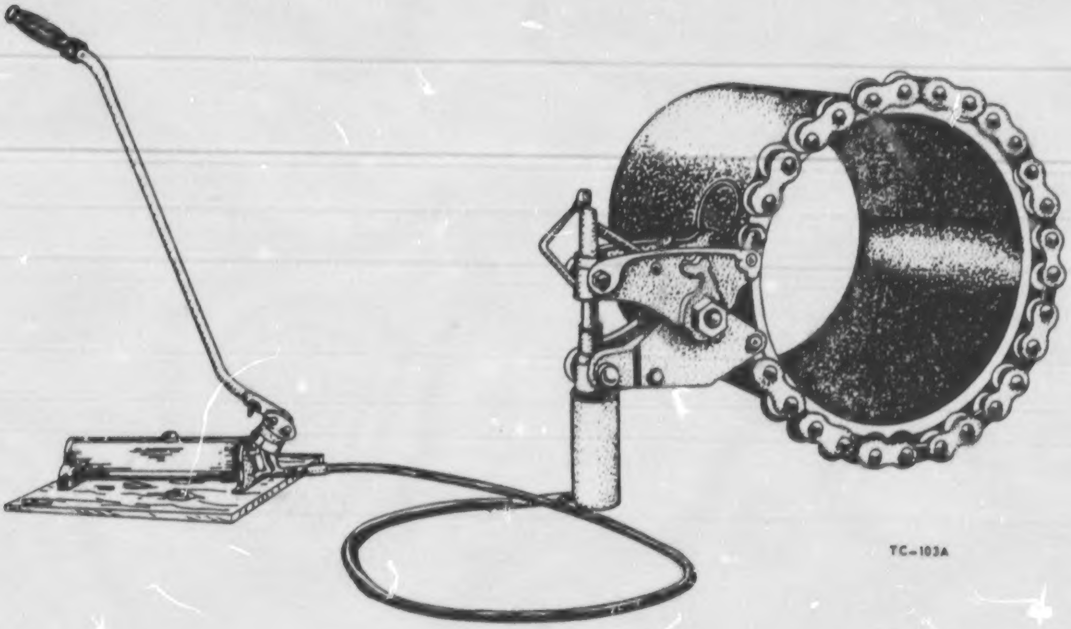


Figure 15. Hydraulic Chain Cutter

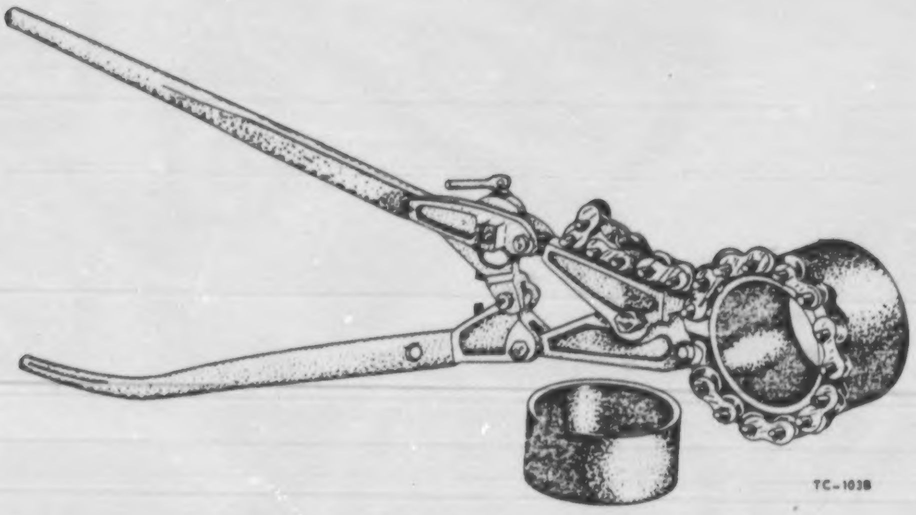


Figure 16. Snap Cutter

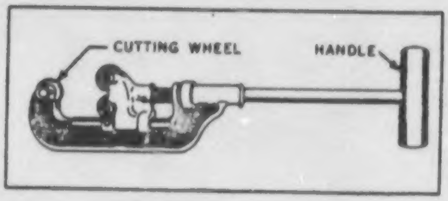

CUTTING WHEEL
HANDLE

Figure 17a. Pipe Cutter

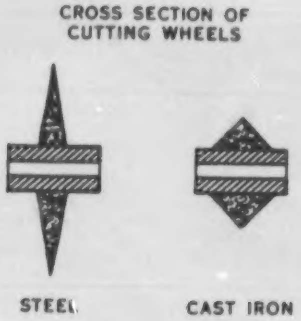

CROSS SECTION OF CUTTING WHEELS
STEEL
CAST IRON

Figure 17. Cutting Wheels for a Pipe Cutter

134

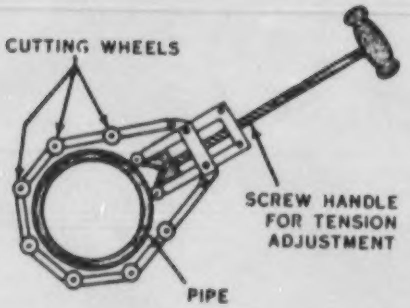


Figure 1 8. Chain Type Pipe Cutter

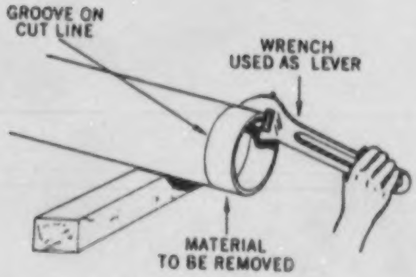


Figure 1 9. Using Wrench to Break Cast-Iron Pipe

If you have to remove only one or two inches of metal from a length of cast-iron pipe, use a hacksaw and an adjustable wrench for this operation. If you try to cut the pipe with a hammer and cold chisel, you will probably break the pipe in the wrong place. To cut one or two inches from the end of a pipe, cut a groove with the hacksaw around the pipe on the line of cut to a depth equal to one-half the wall thickness of the pipe. Now break away the section of the pipe to be removed with an adjustable wrench used as a lever.

COMPRESSED GAS CONTAINERS

Gas cylinders will be moved safely from one location to another by handtruck when possible. Cylinder valves will be closed during movement. Under no circumstances will cylinder valves be used for lifting purposes.

Flammable gas cylinders will be stored with extreme care to prevent fires or explosions. Acetylene cylinders will never be stored in a horizontal position. All cylinders will be secured by a chain or other effective fastening method. Empty cylinders will be plainly marked and in location separate and apart from full containers. Cylinders containing different kinds of gases will not be stored together. Nonflammable gases will be stored in locations separate from flammable gases. Separation by a firewall or other approved firebreaks will be required if the two types of gases are stored in close proximity to each other. Cylinders stored in the open will be adequately protected from extreme heat or cold. Except for acetylene, compressed gas cylinders may be loaded on trucks in a horizontal or a vertical position. Acetylene cylinders will be loaded only in the vertical position. Cylinders fitted with valves and regulators will be loaded so these parts will not be damaged during transportation.

FABRICATING CAST-IRON JOINTS

Melting Furnace

The plumber uses a melting furnace for melting lead and keeping it at the proper temperature for pouring joints. The melting furnace is an extremely valuable tool, but very dangerous,and must be handled with extreme caution to prevent accidents.

The best and most efficient type melting furnace uses liquefied petroleum gas as a fuel. This furnace consists of a burner and valve assembly which mounts directly on a portable propane gas tank. The tank is detachable and can be recharged with fuel. A propane furnace lights instantly and burns with a high temperature blue flame. This furnace should not be subjected to rough treatment since there is always the danger of an explosion from leakage of gas at the connections and valves. A thorough inspection for leaks should be made before lighting the furnace. To light the furnace fold or twist tightly a lighted length of paper under the burner orifice of the burner assembly. See figure 20. Carefully open the fuel regulating valve until the burner lights. If the valve is opened too much or too rapidly the pressure of the escaping gas may extinguish the lighter flame. If this should happen, close the fuel valve immediately and then relight the paper before reopening the valve.

A safe worker will always wear asbestos gloves and shield for protection when lighting a furnace as there is the possibility of receiving burns from a puff or flame or small explosion as the fuel ignites.

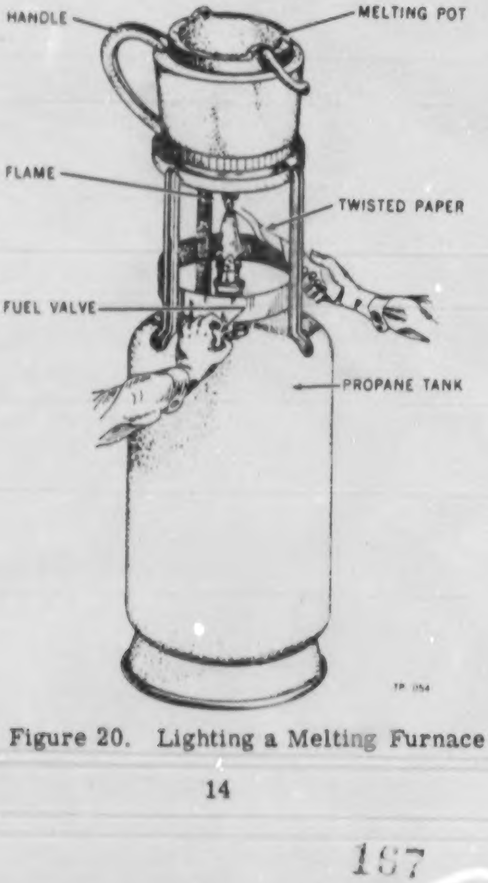


Figure 20. Lighting a Melting Furnace

Lead and Oakum Joints

The oldest method of joining cast-iron soil pipe is made with oakum fiber and molten lead. This provides a waterproof joint that is strong, flexible, and rootproof. When molten lead is poured over the oakum in a cast-iron soil pipe joint, it locks the joint. The hot metal fills a groove in the bell end of the pipe. When the lead cools, the joint is held firmly in place by the lead in the groove.

Pouring a Vertical Joint

Joints in vertical piping are usually the easiest to make and will require fewer tools than joints in horizontal piping. First, inspect the hub and spigot ends of the pipes to be calked to make sure they are free from moisture. If the ends are wet, use a dry rag to wipe the moisture off. If further drying is required, a blowtorch may be used to heat the pipe and fittings. Any moisture in the joint will cause molten lead to spatter when it is poured and may result in serious burns to the plumber. Place the spigot end of the pipe into the hub of the other pipe. Align the pipe so that an equal space between the pipe and the hub is maintained around the circumference of the joint as shown in figure 21. A joint which is not properly centered is apt to leak on the side that has the least amount of oakum.

Yarn oakum into the hub with a yarning iron, as shown in figure 22, and then use a packing iron and a 16-ounce ball peen hammer to pack the oakum tight. Pack the oakum to within 3/4 to 1 inch of the top of the hub to form a solid bed for the lead and to prevent leakage of the joint. After the pipe is placed in service the oakum will absorb moisture and expand to form a water- and gastight seal.

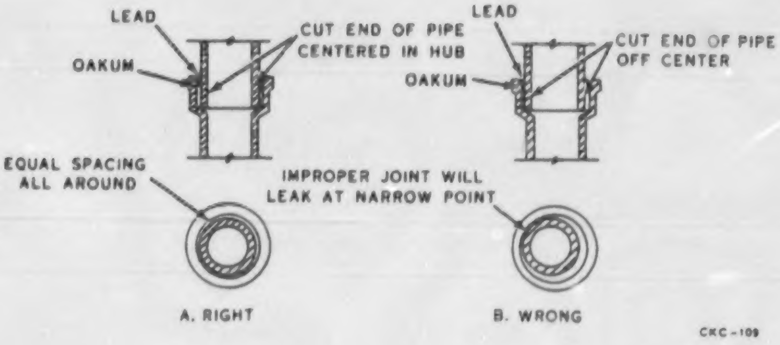

LEAD
OAKUM
CUT END OF PIPE CENTERED IN HUB
LEAD
CUT END OF PIPE OFF CENTER
OAKUM
EQUAL SPACING ALL AROUND
IMPROPER JOINT WILL LEAK AT NARROW POINT
A. RIGHT
B. WRONG
CKC-109

Figure 21. Centering of a Bell and Spigot Joint

After packing the joint with oakum you are ready to pour the lead. As the lead is heated certain products of oxidation and other foreign matter may ride to the surface in the form of slag. This slag must be removed before the lead can be used to pour a joint. This is done by skimming the slag from the lead with a ladle. The ladle should be heated before dipping it into the lead to prevent a buildup of the lead on the ladle. When working in multistory buildings care should be taken not to drop the slag or lead to the floor level below where it might injure other workers.

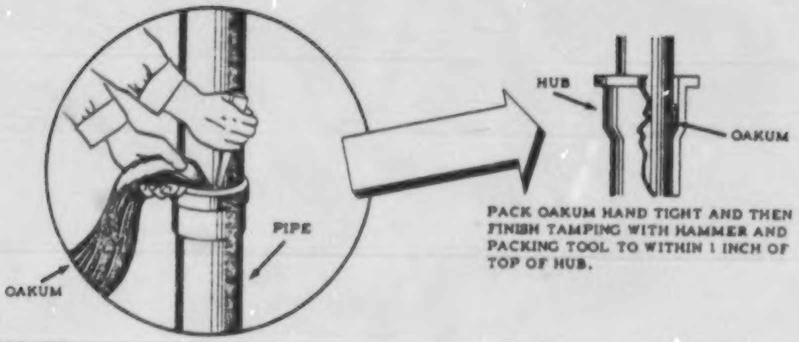
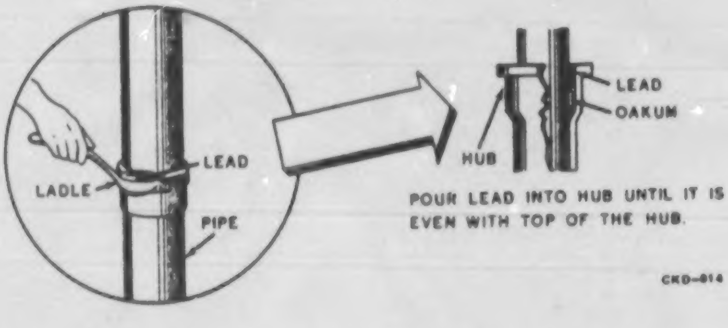

HUB
OAKUM
PIPE
OAKUM
PACK OAKUM HAND TIGHT AND THEN FINISH TAMPING WITH HAMMER AND PACKING TOOL TO WITHIN 1 INCH OF TOP OF HUB.

Figure 22. Packing Oakum into a Joint

After the slag has been removed, dip a ladle full of clean molten lead from the melting pot and carefully pour the lead into the joint until it rises slightly above the rim of the hub. See figure 23. The joint should always be made with one pouring. You will be able to estimate the amount of lead needed for a joint after you have poured several. Figure 24 gives the average amounts of lead and oakum which are required for cast-iron soil pipe joints. These amounts should be allowed in addition to the percent of waste when figuring the material requirements for a job.


LEAD
OAKUM
HUB
LEAD
LADLE
PIPE
POUR LEAD INTO HUB UNTIL IT IS EVEN WITH TOP OF THE HUB.

CKD-014

Figure 23. Pouring Hot Lead into a Joint

Pipe Size (inches)	Oakum or Equivalent (feet)	Lead (pounds)
2	3	1 1/2
3	4 1/2	2 1/4
4	5	3
5	6 1/2	3 3/4
6	7 1/2	4 1/2
8	9 1/2	6
10	12	7 1/2

NOTE: Allow at least 5 percent additional lead and oakum for waste.

Figure 24. Material Requirements for Lead Joints

After the joint has been poured, allow the lead to cool for a minute or so. Select an inside calking iron and place it against the inside edge of the lead projecting from the hub, as shown in figure 25. Strike the calking iron firmly with an 8-ounce ball-peen hammer to calk the lead down upon the oakum. Calk the lead all the way around on the inside first. This forces the lead to compress down and expand into the groove in the hub. Next, use an outside calking iron and calk the lead next to the hub wall in the same way the inside was calked. Be careful not to strike the calking iron too hard as the pressure may cause the hub to crack. A joint of pipe or a fitting which is cracked must be replaced in order to have a watertight joint. The real test for a good job is that the joint is water- and gastight.

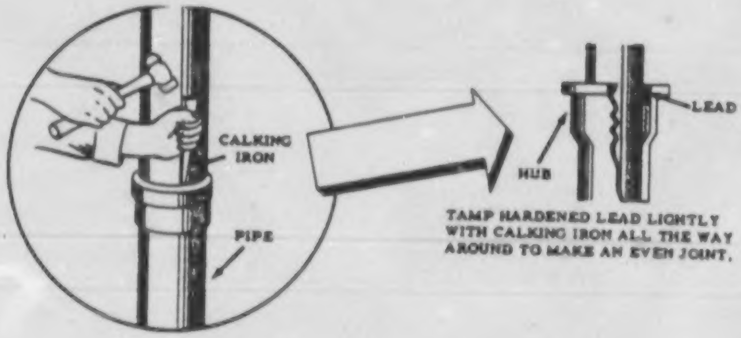
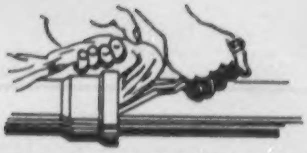

CALKING IRON
PIPE
LEAD
HUB
TAMP HARDENED LEAD LIGHTLY WITH CALKING IRON ALL THE WAY AROUND TO MAKE AN EVEN JOINT.

Figure 25. Calking a Lead Joint

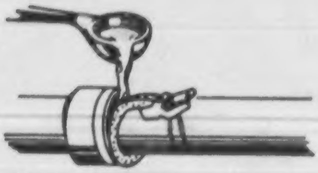
Pouring a Horizontal Joint

To pack and calk a joint on horizontal piping, see that the pipe and fittings are properly supported and set for the desired grade or angle. Pack the hub with oakum in the same manner as it is done to make a vertical joint. An additional tool called the asbestos joint runner must be used while pouring the horizontal joint to direct the molten lead into the hub as shown in figure 26.

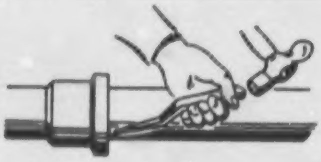
The joint runner is equipped with a spring tension clamp which holds it in place while the joint is being poured. Push the joint runner up against the hub to form a tight dam for the molten lead. A piece of oakum can be used to prevent leakage where the ends of the runner come together at the clamp. Make the joint with one pour and have the lead hot enough to insure a complete run around the joint, before cooling. Continue pouring the lead until the opening at the joint runner clamp is full. Allow the lead to cool and remove the asbestos joint runner. Use a 1/2-inch cold chisel to cut away the excess lead formed by the pouring pocket. The joint can now be calked using the same procedure as was used on the vertical pipe joint.



A. PACK JOINT HALF FULL OF OAKUM.



B. CLAMP JOINT RUNNER AROUND PIPE AND POUR LEAD INTO JOINT.



C. REMOVE JOINT RUNNER WHEN LEAD HAS COOLED AND CALK JOINS JOINT.

CKD-010

Figure 26. Making a Joint in Horizontal Piping

Pouring an Upside-Down Joint

Sometimes during construction of a vent stack, it may become necessary to pour an upside-down joint. Such a joint is permissible when it is located above all drainage lines to the stack. Figure 27 illustrates the procedure for pouring an upside-down joint. A clay or putty funnel is formed above the pouring opening in the asbestos joint runner to force the lead to flow up into the hub. The funnel must be deep enough to raise the level of the lead inside the hub to a height sufficient to bring it in contact with the oakum. Extreme caution must be exercised when pouring this type joint to prevent serious burns from splattering or falling lead. The putty or clay funnel must be absolutely dry and free of all moisture before pouring the lead to prevent blowout of the hot lead caused by the formation of steam. After the lead has cooled, the joint runner is removed and the lead is calked in the same manner as other lead joints.

Always keep in mind the dangers involved when working with and handling hot lead and heating devices. Take your time and plan your moves ahead to avoid accidents to yourself, your co-workers, and your equipment.

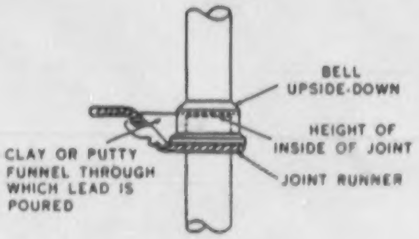

BELL UPSIDE-DOWN
HEIGHT OF INSIDE OF JOINT
CLAY OR PUTTY FUNNEL THROUGH WHICH LEAD IS POURED
JOINT RUNNER

Figure 27. Pouring an Upside Down Joint

Positioning and Blocking the Stack Base and Fittings

The location of the building drain is determined by the location of the main stack and the location of the house sewer.

The building drain is located below the floor and may be underground or suspended from the basement ceiling. A stack is the vertical piping which directs the sewage flow from above to the building drain. The number of stacks required and their exact location is determined by the location of the fixtures within the building. The fitting which serves as a stack base and on which the stack will later be constructed must be positioned and installed when the building drain is fabricated.

Figure 28 shows how a 90° Y branch (sometimes called a combination Y and 1/8 bend) is installed at the base of the stacks. The blocking under the stack base is necessary to exactly position the fitting under the floor opening to accommodate the stack and to prevent settling when the weight of the stack is added. The house drain is laid to grade and the fall should not exceed 1/4 inch per running foot.

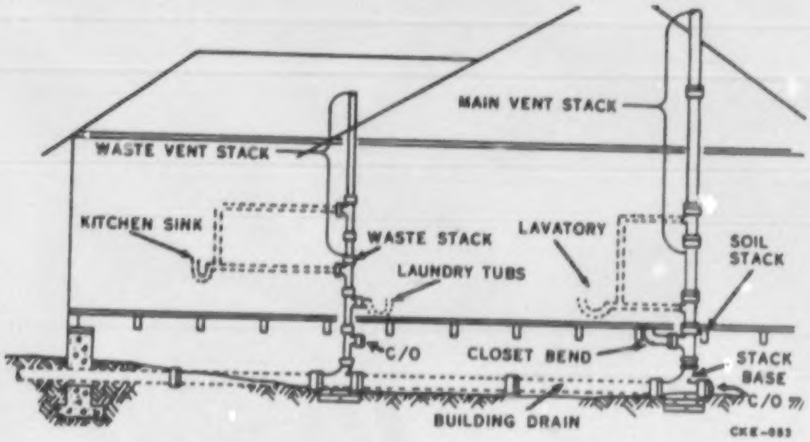


Figure 28. Building Drain

SUMMARY

To successfully plan and lay out a plumbing system, you must be able to read and interpret blueprints and drawings. A working drawing should be made, using information from the blueprints, showing the location of all fixtures, pipes, and fittings. The drawings should contain only the plumbing systems of the building and should be complete to the extent that it could be used for determining pipe lengths as you figure material requirements for the job. Accuracy is required in preparing the drawing and in laying out the various phases of the system.

The design and construction of the building drain is very important since a stoppage or failure here would make the entire drainage system inoperative. The location of fitting for all waste lines and stacks in the building drain must be determined to insure proper connection with the other parts of the drainage system. Cast-iron soil pipe can be cut in several ways but the hammer and chisel method is the oldest used on the job.

Extreme caution is necessary when using a melting furnace and pouring hot lead into cast-iron pipe joints. Be safety minded at all times. Any bodily contact with hot lead or hot equipment being used will cause serious burns.

QUESTIONS

1. What is the purpose of the building drain?
2. How much fall per foot should a building drain have?
3. What is the purpose of blocking a stack base?
4. What tools would be used to cut 2 inches from the end of a length of cast-iron soil pipe?
5. What is the result of using heavy hammer blows when calking lead into a cast-iron joint?
6. How can you determine when molten lead is in the correct temperature range for pouring?
7. What is the difference between a pipe cutter for steel pipe and one for cast iron?
8. Name four methods used to cut cast-iron soil pipe?
9. What does yarning a joint mean?
10. What is meant by calking a joint?

VENTS AND STACKS

OBJECTIVE

Upon completion of this unit of instruction, you will be able to determine the type, location, and configuration of a vent and stack system, make a sketch of a vent system, select material to construct a vent system in your booth area, and assemble and grade a completed system.

INTRODUCTION

A venting system consists of nothing more than a piping system which permits air or gas to pass through it. Without a venting system, however, fixture drain traps will lose their seal, water will not flow properly, and sewer gases will build up pressures causing serious health hazards.

TYPES OF STACKS

Stacks

A stack is a vertical main of a system of soil, waste, or vent piping.

Stack Group

A stack group is a term applied to the location of fixtures in relation to the stack so that, by means of proper fittings, vents may be reduced to a minimum.

Main Stack

Every building in which plumbing is installed shall have at least one main stack, which shall run undiminished in size and as directly as possible from the building drain to fresh air above the roof (see figure 29).

Vent Stack

A vent stack is a vertical pipe which provides circulation of air through the drainage system. This piping should not receive waste.

Stack Vent

The stack vent is the extension of a soil or waste stack, but on the portion of the pipe which is above the highest fixture run or branch inlet (see figure 29).

Waste Stack

A waste stack is the vertical pipe which carries waste from any fixture, except water closet or urinals (see figure 29).

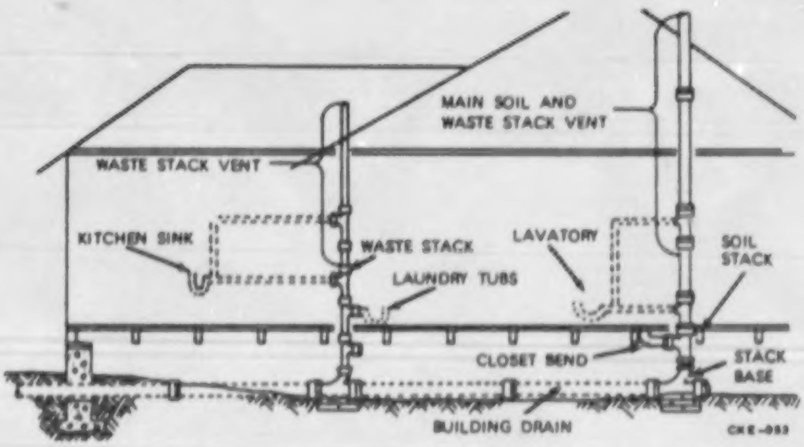

MAIN SOIL AND
WASTE STACK VENT
WASTE STACK VENT
KITCHEN SINK
WASTE STACK
LAVATORY
SOIL
STACK
LAUNDRY TUBS
CLOSET BEND
STACK
BASE
BUILDING DRAIN
CKE-053

Figure 29. Identification of Stacks

Soil Stack

A soil stack is the vertical pipe which carries soil from water closets, urinals, and/or similar fixtures (see figure 29).

Soil and Waste Stack

A soil and waste stack is a vertical pipe which receives the discharge from soil and waste branches.

Materials

Stacks and waste pipes may be made of cast iron, steel, brass, plastic, or copper. Soil stacks are usually made of cast-iron soil pipe. The principal objection to the use of copper for soil and waste pipes is its high initial cost; otherwise, it has proven very satisfactory.

OPERATION AND CONSTRUCTION OF A VENT SYSTEM

The layout and construction of the stack in a plumbing system requires as much knowledge and skill on the part of the plumber as any job he may perform. Accurate measurement is absolutely necessary to insure proper positioning of fittings in the stack for soil branches, waste branches, and vent pipes to the various fixtures. The fittings and pipe must be assembled in perfect alignment as most stacks are concealed in walls where space is limited.

Although plumbing codes vary, they carefully regulate the size of piping for a particular type of vent. First, the size of the piping used for a soil or waste stack vent must be not less than the diameter of the soil or waste stack piping. When a main vent is added to a stack, it must have a diameter of at least one-half the diameter of the stack it serves, but in no case can the main vent be less than 1 1/4 inches in diameter.

There are several approved methods for ventilating a plumbing system. The one which is used will be determined by the design of the building, the number of fixtures, and the manner in which they are grouped or located. On small single-story plumbing installations where the fixtures are grouped so that the fixture traps attach directly to the fittings in the stack, no additional venting is necessary other than the stack vent. In buildings where the fixtures are located away from the stacks and drainage piping is necessary, or in multistory buildings where fixtures are installed in the upper floors, additional venting will be necessary to insure adequate ventilation of the system.

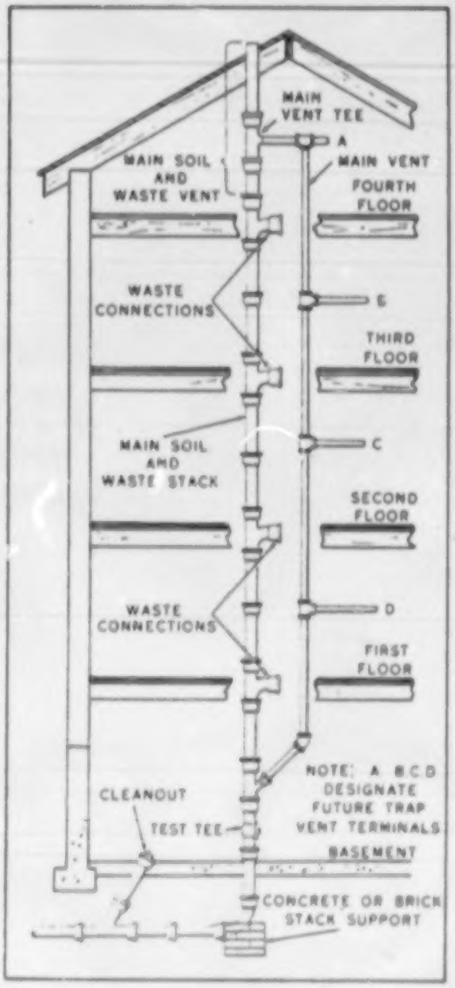

MAIN VENT TEE
A
MAIN SOIL AND WASTE VENT
MAIN VENT
FOURTH FLOOR
WASTE CONNECTIONS
B
THIRD FLOOR
MAIN SOIL AND WASTE STACK
C
SECOND FLOOR
WASTE CONNECTIONS
D
FIRST FLOOR
NOTE: A B C D DESIGNATE FUTURE TRAP VENT TERMINALS
CLEANOUT
TEST TEE
BASEMENT
CONCRETE OR BRICK STACK SUPPORT

Figure 30. Stack and Vent Installation

Main Vent

The main vent is a vertical vent pipe which runs parallel to the soil or waste stack and serves as a terminal for the vent piping from the individual fixtures, as illustrated in figure 30. It is an integral part of the vent system and is constructed in conjunction with the main stack. The main vent connects full size at its base into the the soil or waste stack through the Y fitting. This connection is made below the lowest fixture branch. It extends full size through and above the roof, or to a point of connection with the stack vent above the highest fixture branch. The fitting for this connection is referred to as the main vent tee and is also shown in figure 30. In most installations, the main vent is located within a few feet of the main stack but it may be offset where special problems exist.

Unit Vent

Fixtures which are mounted side by side or back to back, as shown in figure 31, are unit vented. A unit vent, sometimes called a dual vent, is a vent pipe installed to protect two fixture traps.

Individual or Back Vent

Figure 32a and 32b illustrate the installation of a single fixture when a main vent is used. Note the drainage through the waste pipe to the main stack. The vent pipe above the trap is connected to the main vent. This method of venting a fixture is referred to as an individual vent. The vent piping must rise vertically at least 6 inches above the fixture rim before changing direction for connection to the main vent. The fixture is said to be dry vented as there is no drainage flow through the vent piping in the system.

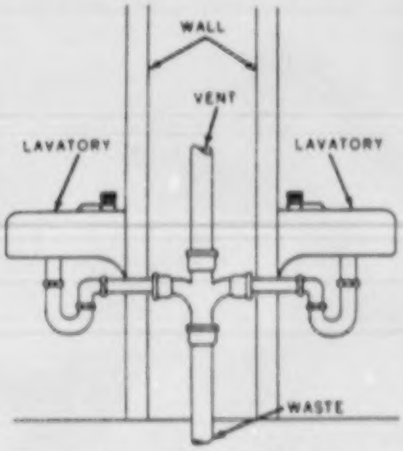

WALL
VENT
LAVATORY
LAVATORY
WASTE

Figure 31. Pair of Fixtures Unit Vented

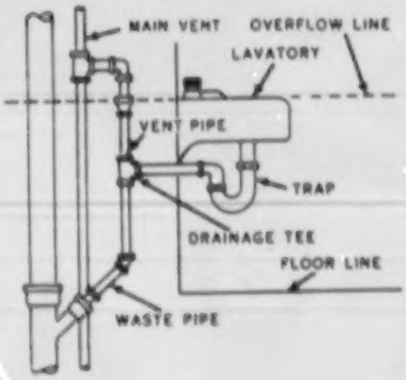

MAIN VENT
OVERFLOW LINE
LAVATORY
VENT PIPE
TRAP
DRAINAGE TEE
FLOOR LINE
WASTE PIPE

Figure 32a. Single Fixture Individually Vented

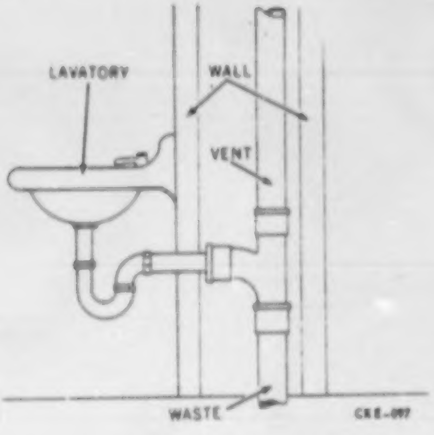

LAVATORY
WALL
VENT
WASTE
CKE-097

Figure 32b. Individual Vent

Circuit Vent

The circuit vent, illustrated in figure 33 is the vent from a horizontal branch taken between the first two fixtures and connecting into the main vent. There should be no more than eight fixtures on one circuit vent.

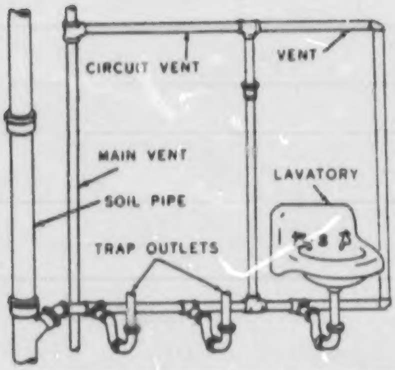

CIRCUIT VENT
VENT
MAIN VENT
SOIL PIPE
LAVATORY
TRAP OUTLETS

Figure 33. A Battery of Lavatories Circuit Vented

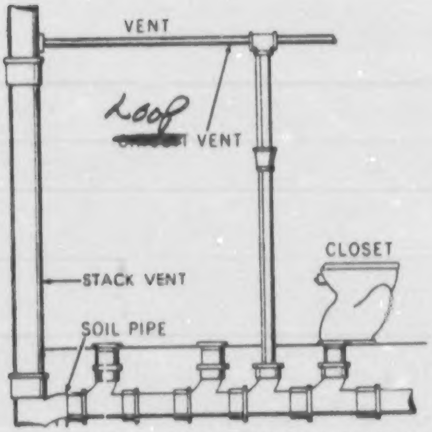

VENT
Loop
~~CIRCUIT~~ VENT
STACK VENT
CLOSET
SOIL PIPE

Figure 34. Water Closet Battery Loop Vented

Loop Vent

The loop vent is similar to the circuit vent in figure 34, except that it ties to the soil or waste stack vents.

Wet Vent

A wet vent is a vent which receives the discharge from waste other than water closets (figure 35) illustrates a shower trap which is wet-vented through the lavatory waste pipe.

Relief Vent

A relief vent (see figure 36) is installed to prevent excessive pressure from developing in the drainage system that may cause siphonage or back pressure to nearby fixtures. This pressure is relieved at congested points where the flow tends to develop slugs, causing overloads on the drainage system because of the lack of proper air circulation.

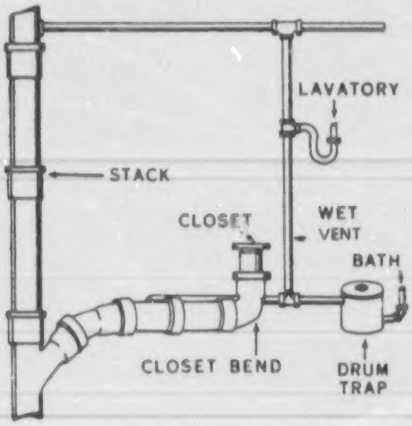

LAVATORY
STACK
CLOSET
WET VENT
BATH
CLOSET BEND
DRUM TRAP

Figure 35. A Group of Fixtures with a Wet Vent

Where water flowing in a horizontal pipe is offset to a vertical, there is a tendency for the water to accelerate and could siphon the fixtures installed close to the offset. A relief vent dissipates this negative pressure by introducing air and prevents siphonage of the fixture traps in its path. Whenever the water in a trap is removed, the trap loses its seal. Trap seal loss is usually caused by direct siphonage, indirect siphonage, evaporation, or capillary action. See figure 37.

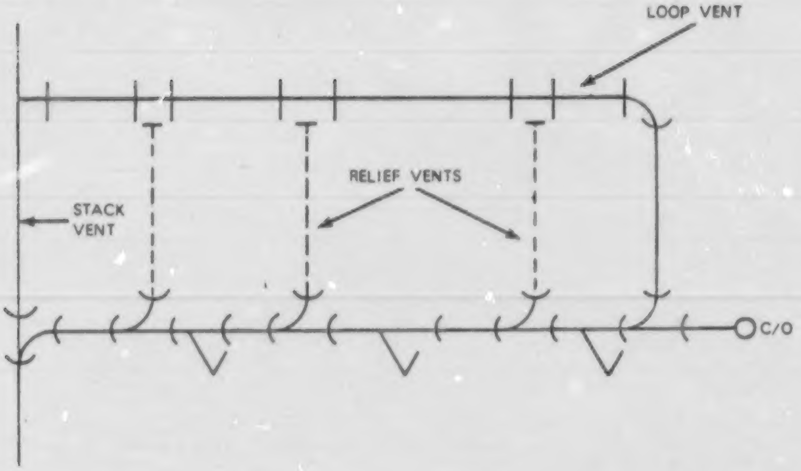
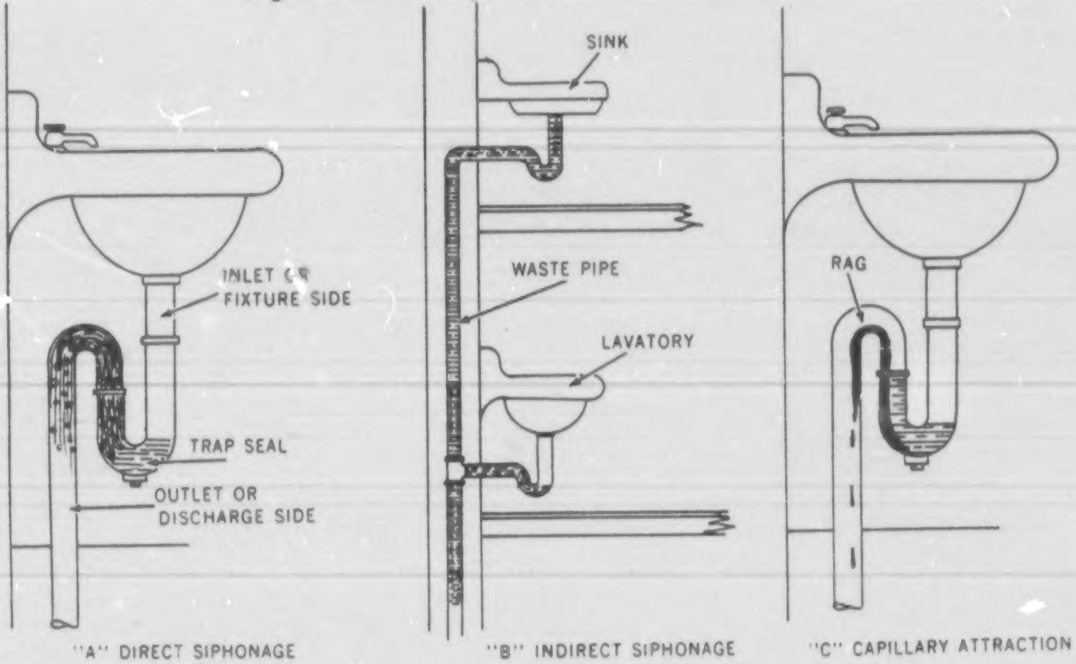

LOOP VENT
RELIEF VENTS
STACK VENT
C/O

Figure 36. Battery of Fixtures with Relief Vents


INLET OR FIXTURE SIDE
TRAP SEAL
OUTLET OR DISCHARGE SIDE
SINK
WASTE PIPE
LAVATORY
RAG

"A" DIRECT SIPHONAGE

"B" INDIRECT SIPHONAGE

"C" CAPILLARY ATTRACTION

Figure 37. Loss of Water Seal

CKE-096

LP- 75-830

Capillary Attraction

The loss of the water seal in a trap due to capillary attraction is caused by some foreign object lodged in the trap which acts as a wick and carries the water from the trap over the outlet side and down the drain. Some common objects which may cause this trouble are lint, string, and hair.

Direct Siphonage

Direct siphonage occurs as the result of a pressure lower than atmospheric pressure on the discharge side of a trap. This condition allows the atmospheric pressure on the fixture side of the trap to push the water seal through the trap and down into the drainage line. Direct siphonage usually occurs when unventilated traps are used.

Indirect Siphonage

The loss of the water seal in a trap, sometimes referred to as siphonage by momentum, is caused by the discharge of a large volume of water from a fixture which is installed one or more floor levels above the affected fixture. The discharge of the water tends to reduce the pressure on the discharge side of the trap and thereby breaking the seal.

Evaporation

The loss of water from a trap by evaporation occurs when the fixture is not used for a considerable length of time. The rate of evaporation of the water depends upon the humidity and temperature of the atmosphere. A trap located in a place where the temperature is high and the air is dry will tend to lose its water seal by evaporation more rapidly than one in a cool and damp room. It is difficult to stop the evaporation of water from a trap when it is only used occasionally. The installation of a deep seal trap is a partial solution since it has a 4-inch seal instead of the 2-inch seal which is found in the common seal trap.

ASSEMBLY AND ALIGNMENT OF BUILDING DRAINS

Vents and Stacks

When assembling the building drain and vents, the plumber must determine if that portion of the work can be fabricated and then set in place, or if it must be done in place. There should be sufficient room near the joint for yarning, packing, and pouring if the joint is assembled in place.

When aligning vertical and horizontal piping, a carpenter's level should be used. On vertical piping, this assures that the hubs will be encased within the wall.

The stack must be carried full size or larger through the roof to form a vent terminal. The stack must extend at least 3 inches above the roof. To make openings watertight, a roof flashing must be used. This is shown in figure 38. All piping, horizontal or vertical, must be supported when necessary. This is done with hanging straps, pipe hangers, and clamps.

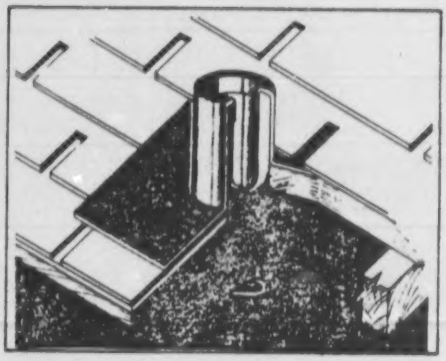


Figure 38. Roof Vent Flashing

Joining Cast-Iron Soil Pipe

The types of joints that are made with cast-iron soil pipe are, bell-and-spigot using lead and oakum or using a compression gasket, and no-hub pipe which is connected using a rubber seal and a stainless steel clamp.

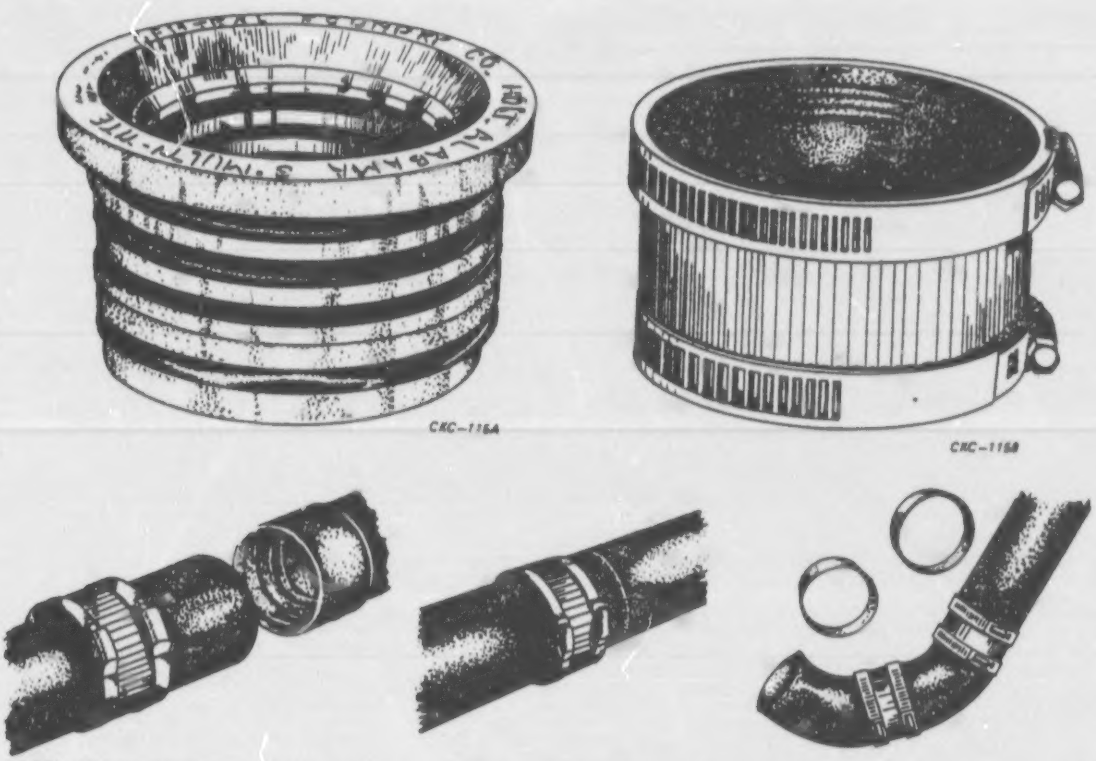
Rather than working with molten materials as with the poured calked joint, you may be required to use a flameless method of joining soil pipe. Some of these methods are cold calking, compression joint, and the no-hub connection.

COLD-CALKED JOINTS. When molten lead connot be used, such as under water or where the use of an open flame is dangerous, joints in cast-iron soil pipe may be made by cold-calking with lead wool or shredded lead. Roll the material into several strands, approximately 1/2 inch in diameter and 1 and 2 feet long, and then force it into the bell of the joint and calk in place.

COMPRESSION JOINT. The compression joint uses hub-and-spigot pipe as does the lead-and-oakum joint. The major differences are the one-piece rubber gasket and the spigot end of the pipe and fitting which is always plain, or without a bead. When the spigot end of the pipe or fitting is lubricated and pushed or drawn into the gasket hub, the joint is sealed by displacement and compression of the rubber gasket. The resultant joint is leakproof, rootproof, and pressureproof. It absorbs vibrations and can be deflected up to five degrees without leakage or failure (see figure 39).

NO-HUB JOINT. The no-hub joint for cast-iron soil pipe supplements the lead-and-oakum and compression-type bell-and-spigot joints by providing another and more compact arrangement. This system uses a one-piece neoprene gasket and a stainless steel shield and retaining clamps. The advantages of this system are that it permits joints to be made against a ceiling or in any limited-access area, and it is constructed using 2 and 3 inch sizes that will fit into 2 by 4 partitioned walls. Other advantages of this type of system are that installation is fast and efficient and few tools are required.

FABRICATING NO-HUB. When measuring no-hub pipe, measure the full length of the pipe (end to end). Spacers inside of the neoprene gasket where the fittings or pipe ends meet, measure 3/32 of an inch; therefore, when fabricating a system, subtract 3/32 of an inch for each connection. Tightening the stainless steel retaining clamps is accomplished with a torque wrench. The desired degree of tightness is not less than 48 nor more than 60 inch-pounds of torque. Extra hangers are required for no-hub systems, see figure 39.

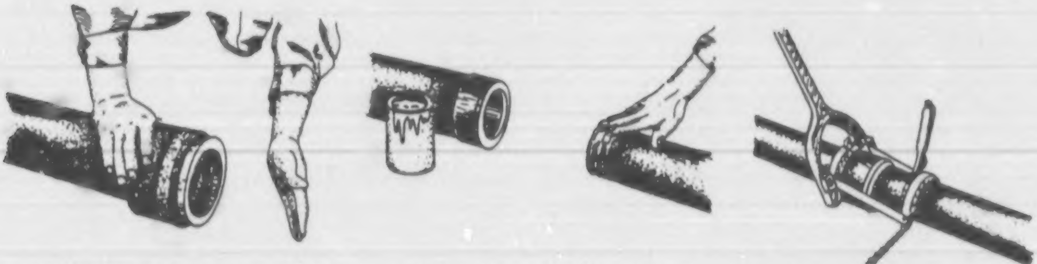


PIPES ARE POSITIONED BY SEPARATOR RING IN GASKET

CLAMP IS SLID OVER GASKET AND TIGHTENED

COMPLETED JOINT

CKC-115C



NEOPRENE GASKET IS INSERTED INTO CLEANED HUB

LUBRICANT IS APPLIED TO SPIGOT END

PIPES ARE JOINED WITH PULLING TOOL

Figure 39

SUMMARY

In planning the layout of the main soil stack, the location and the type of soil fittings necessary for the waste and vent piping must be determined. Accurate measurement for cutting soil pipe to assemble the fittings, in proper relation to the fixture locations, is necessary. A trial assembly of the stack should be made before the joints are poured. Portions of the stack which must be fabricated before they are installed, due to the lack of working space, should be noted. A final check for accuracy in all measurements should be made. The vent stack may be constructed and continued through the roof, providing the roof framing of the structure is in place. Brace the stack where it passes through each floor level and at points where the connection of waste pipes might cause undue stress on the stack.

QUESTIONS

1. What is the purpose for a venting system?
2. How is the size of stack determined?
3. What is a soil stack?
4. What is a waste stack?
5. What is a vent stack?
6. What is a main vent?
7. How is a trap seal lost?
8. What is a wet vent?
9. What is a circuit vent?
10. What is a unit vent?

REFERENCES

1. AFM 85-20, Plumbing.
2. AFM 88-8, Chapter 4, Plumbing.

FLOOR DRAINS AND ROOF DRAINS

OBJECTIVE

The objective of this study guide is to familiarize you with waste rough-in for roof, floor, and shower drains.

INTRODUCTION

Floor and shower drains are used to convey contaminated water to the sanitary sewer, while the roof or area drains convey water to the storm sewer. A drain which functions improperly may cause a serious problem by causing water damage to the contents of a building. Floor drains are used extensively in Air Force buildings and you, as an Air Force plumber, should know the proper methods of installing these drains so they will function properly.

PURPOSE AND TYPES OF DRAINS

Floor Drains

Floor drains are usually installed for one of two reasons: first, they may be installed in the floor of a work area which requires that the floor be washed down regularly for cleanliness. An example of this would be the kitchen or dishwashing areas in a dining hall. Second, it may be necessary to install a floor drain as a precaution against flooring in certain areas. A floor drain should be located near the urinals in a latrine. Urinals often overflow due to soil pipe stoppage or a malfunction in a flushometer.

When floor drains are used in industrial areas such as hangars, aircraft washdowns and vehicle washrack areas, drains will be equipped to separate any oil, gas, or lubricants. It is unlawful for anyone to discharge any oil, gas, or lubricants in a public sewer system.

Purpose of Roof Drains

The primary purpose of installing drains on roofs is to remove rain or melting snow as quickly as possible. This is more important on flat roofs than roofs built with pitch. If a roof drain becomes clogged, it would be possible for the roof to overload with water and collapse, causing damage not only to the building and its contents but a loss of human life.

Interior Roof Drains

Interior roof drains have the pipe within the building (see figure 40). The pipelines, like all other systems, must be gas-, air-, and watertight. The pipes must be supported at proper intervals.

A swing joint or an expansion joint must be used at the roof terminal of the drain in case of pipe shifting, pipe contraction or expansion, and allowing for settling of the building. (See figure 41.) In addition, a base should be constructed to support the main vertical pipe.

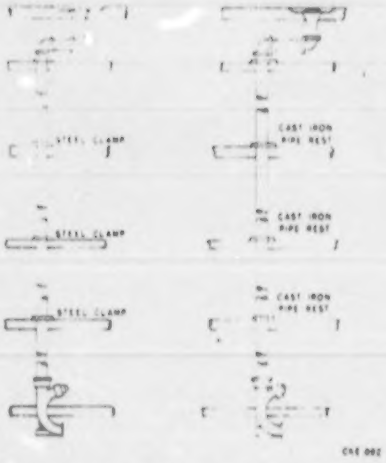

STEEL CLAMP
STEEL CLAMP
STEEL CLAMP
CAST IRON PIPE REST
CAST IRON PIPE REST
CAST IRON PIPE REST
CKE 092

Figure 40. Interior Roof Drain

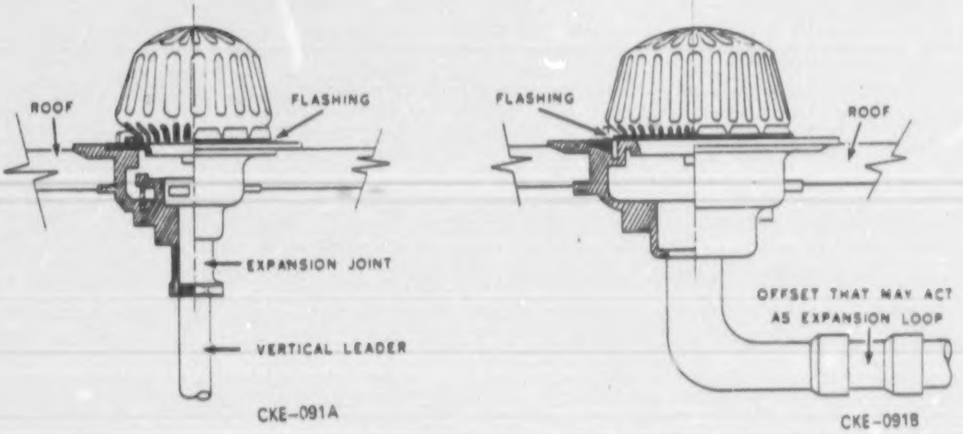

ROOF
FLASHING
EXPANSION JOINT
VERTICAL LEADER
CKE-091A
FLASHING
ROOF
OFFSET THAT MAY ACT AS EXPANSION LOOP
CKE-091B

Figure 41. Expansion Joint and Expansion Loop

Exterior Roof Drain

In the exterior roof drain, the pipe is exposed and secured to the outside wall (see figure 42). These drains can be designed with a roof drain or a hanging gutter. The downspout must be watertight, and can go to a splash plate or a storm sewer.

Roof Drain Strainers

There are three basic types of roof drain strainers: flat surface, mushroom, and sloped. Flat strainers

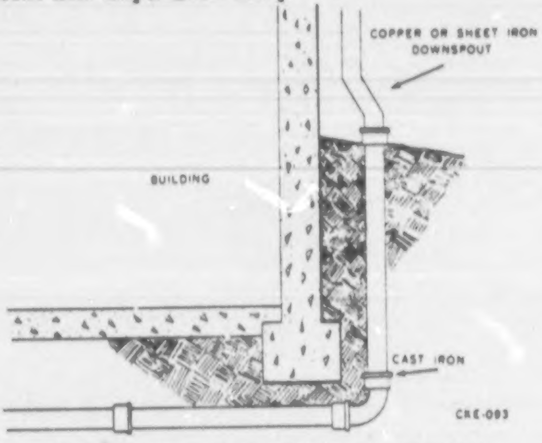

COPPER OR SHEET IRON DOWNSPOUT
BUILDING
CAST IRON
CKE-093

Figure 42. Base Fitting Assembly for Outside Roof Leaders

are necessary on a roof that is utilized as a sun deck, parking lot or roof garden. (See figure 43.)

Mushroom strainers provide a large elevated area for flat roofs where leaves and other debris may accumulate. (See figure 44.)

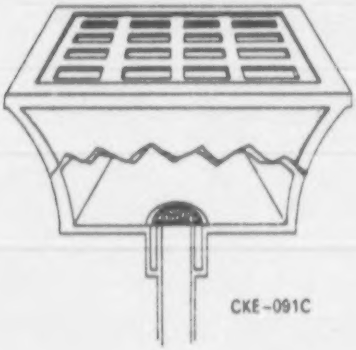


Figure 43. Flat Strainer

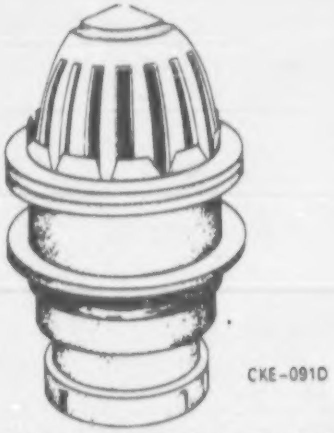


Figure 44. Mushroom Strainer

Sloped strainers and corner strainers are necessary when the drain is located in a patched roof or where the drain is placed at the corner of the roof. (See figure 45.)

Size of Roof Drain

The size of the roof drain is based on the amount of rainfall or snow, and the size of the area to be drained. The open area of the strainer should be 1 1/2 to 2 times the area of the pipe to which it is connected.

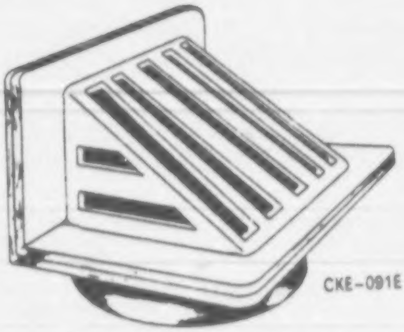


Figure 45. Sloped Drain

Roof Flashing

Roof flashing is installed between the roof drain strainer and piping. It makes a seal at the opening through the roof. Another reason is to gather any moisture that might accumulate between the ceiling and the roof. (See figure 46.)

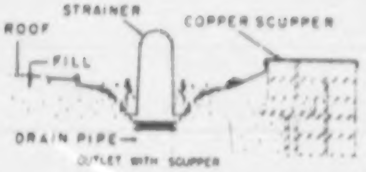


Figure 46. A Roof Drain

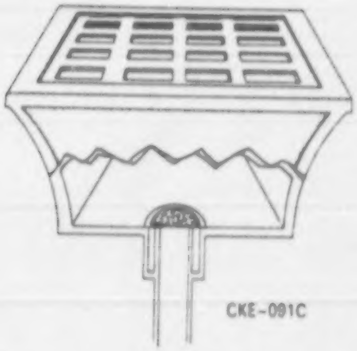


Figure 47. Area Drain Strainer with Sandtrap

Area Drains

Areas drains are somewhat like floor drains except they are located outside and are used to drain such areas as platforms, basement entryways, driveways, etc. They are usually designed with a sandtrap to prevent sand from entering the drain system. (See figure 47.)

Types of Traps in Drain Systems

Floor drains used with sanitary sewers are considered to be plumbing fixtures, and like fixtures, must have a trap. The P-trap is the most common type used for these floor drains. Drains are designed with common seal P-traps as shown in figure 48. and also with deep seal P-traps as shown in figure 49. The common seal trap has a water seal of 2 inches while the deep seal has a 4-inch water seal. The common seal trap should be vented while the deep seal trap is used in situations where the trap cannot be vented. The deep seal trap (not often used) may also be in floor drains. It offers greater resistance to siphonage, due to the larger volume of water it contains, it is also ideal if there is a possibility of trap seal loss due to enaporation.

Figure 50 illustrates a P-trap type of floor drain assembly which has a cleanout plug concealed under the strainer plate. This type of trap is used in concrete floors when it is impossible to make other provisions for cleaning the waste line and trap.

Another type of floor drain is the sump or cesspool type shown in figure 51. This drain is designed with a bell trap instead of a P-trap. Notice that the bell is attached to the strainer plate. The position of the bell over the outlet pipe forms the trap. The sump catches a large percentage of the silt and dirt that drains into it with the water. The strainer plate with the bell can be removed to clean the sump and trap.

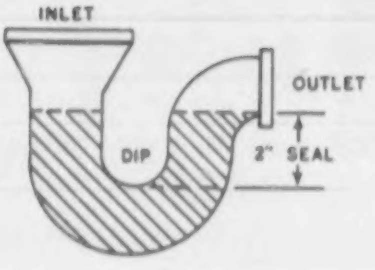

INLET
OUTLET
DIP
2" SEAL

Figure 48. A P-Trap with a Common Seal

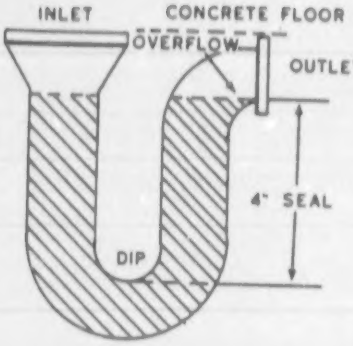

INLET
CONCRETE FLOOR
OVERFLOW
OUTLET
4" SEAL
DIP

Figure 49. A P-Trap with a Deep Seal

SP- 75-830

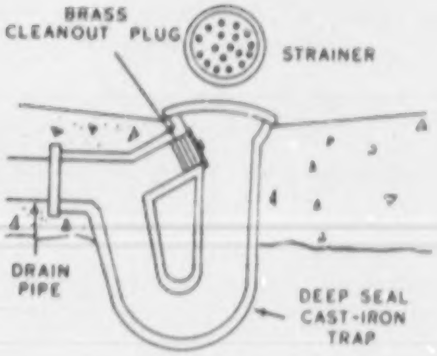

BRASS CLEANOUT PLUG
STRAINER
DRAIN PIPE
DEEP SEAL CAST-IRON TRAP

Figure 50. A Drain with a Cleanout Plug

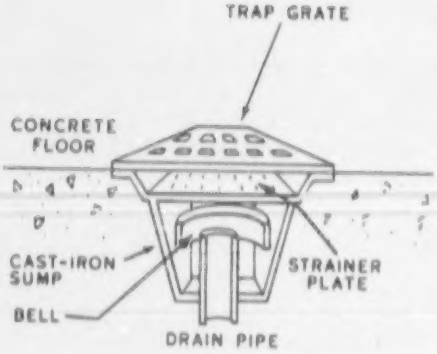

TRAP GRATE
CONCRETE FLOOR
CAST-IRON SUMP
BELL
STRAINER PLATE
DRAIN PIPE

Figure 51. A Sump Type Floor Drain

METHODS OF INSTALLING FLOOR AND ROOF DRAINS

Floor, shower, and roof drains have their own particular method of installation. There are certain methods that must be followed for these units to function properly.

Floor Drains

The smallest diameter of pipe used for waste lines which serve floor drains is 2 inches. The waste pipe should be installed with a fall of 1/4 inch to the foot. Waste pipes, with a diameter of 3 inches or larger, may have a fall of only 1/8 inch to the foot. All traps and pipes which are to be embedded in soil or concrete should be constructed from cast-iron pipe and fittings. All bell-and-spigot joints should be leaded and the threaded joints must be tightened to make a watertight and gastight seal. When a concrete floor is to be installed, the rough-in pipes and the traps must be firmly secured and anchored in place to prevent shifting or movement as the concrete is poured.

All floors must have a slope to direct water into the drain if a floor drain is to be installed. The blueprints for the job should be studied very carefully to determine the proper level for installing the drain opening. It must be flush with the low point in the slope when the floor is poured.

Whenever a floor drain is to be installed in the upper floor of a multi-story building, the floor must be absolutely waterproof to prevent damage to the ceilings in the lower rooms. This can be insured by installing a lead or copper pan beneath the concrete to direct any seepage through the floor into the drain. Figure 52 shows a typical installation of this type. Sometimes it is permissible for the lead pan to extend on 3 or 4 feet from the drain, rather than cover the entire floor, as is required in shower rooms. The specification sheet for the job should indicate the size of the pan required.

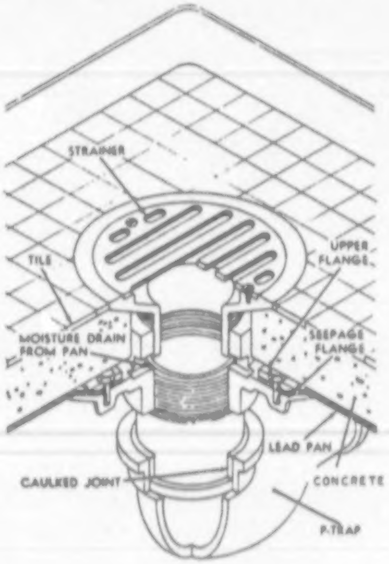


Figure 52. Floor and Shower Drain with Seepage Flange

Roof Drains

When installing roof drains, care must be taken to position them at the lowest roof level so that water will readily drain into them. Cut out the opening for the drain and construct any brackets or hangers which are necessary to hold the drain in a rigid position. (See figure 53.)

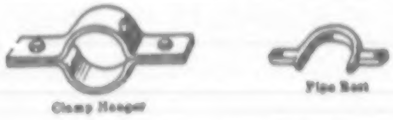


Figure 53. Bracket or Hanger

In case the drain is to be embedded in a concrete roof, it will be necessary to install the drain before the concrete is poured. All joints in the line, as well as in the scuppers should be soldered during the installation. Bituminous compound should be used whenever necessary to insure that the job is waterproof.

Gutter and gutter outlets should be properly designed to carry off the water. When the outlets are inadequate, the water will either back up behind the flashing and leak into the building or spill over the sides of the gutter and cause staining of the exterior walls. The gutter should have the proper pitch to run off the water and should be designed with a minimum depth. Deep and flat gutters may fill with snow and ice and the thrust of the freezing water may cause breaks and leaks.

Leaders or downspouts can be rectangular or round tubing. Round is better because it offers less resistance to flow because of friction loss. Rectangular leaders need to be larger than round leaders.

When interior drains are used, some provision should be made for an overflow. If an overflow is not provided, any outlet stoppage will cause an overflow of water into the building.

MAINTENANCE OF FLOOR AND ROOF DRAINS

Floor and roof drains must be maintained to function properly. The location and contents running through these drains will have a determining factor on the type maintenance required.

Floor Drains

SP 76-830

The maintenance of floor drains will mainly consist of cleaning the strainer and trap of floor sweepings and other foreign objects which are carelessly swept and washed into the drains. The only prevention for this is to keep the area being served by the floor drain clean, and above all, do not sweep debris into the drains. Floor drains which are seldom used will lose their trap seal through evaporation. This will result in foul odors entering the building through this drain. The best prevention for this is to use the drains more regularly. If this is not practical, the traps will have to be refilled with water at regular intervals to overcome this condition.

Roof Drains

Maintenance of roof drains will consist of keeping the gutters free of leaves, twigs, and other debris. Special attention should be given to the strainer since these same leaves and twigs seem to wash to this point of the system. When this happens, the roof drain will eventually become completely clogged and inoperative. In cold climates, roof drains will often become clogged with ice and snow. When this occurs, a blowtorch can be used to melt the ice and snow but all safety precautions must be observed, since there is always the possibility of seriously burning yourself or causing the building to catch fire.

SUMMARY

Floor drains are installed for convenience in cleaning an area or for protection against flooding. A common seal P-trap is used when the trap can be vented and a deep seal P-trap is used when the trap cannot be vented or is seldom used. Cast-iron pipe and fittings are used when installing drainage pipe under concrete floors. Vitrified clay pipe may be used to drain areas outside the building. The smallest diameter of pipe which may be used for a floor drain is 2 inches. A fall of 1/4 inch to the foot run is desirable. When the pipe diameter is larger than 3 inches, the fall may be reduced to 1/8 inch per foot but this should be avoided in drains which must carry a high dirt or silt content in the liquids.

Roof drains are used to drain water from roofs caused by rain or melting snow, ice and hail. These drains are constructed at the lowest portion of the roof so that water may drain into them. The drain pipes for roof drains may be installed in partitions or in exterior walls. Roof drains should be well sealed to prevent water seeping into the building.

QUESTIONS

1. What is the purpose of a floor drain?
2. What size waste pipe is used to rough-in a floor drain?
3. What is the purpose of the lead pan which is used on some floor drain installations?
4. What is the difference in the design of a common seal P-trap and a deep seal P-trap?
5. Why must the slope of the floor be considered when installing a floor drain?
6. Why is a deep seal P-trap used in floor drains which receive only occasional use?
7. What kind of pipe should be used when installing a drain beneath concrete?
8. What is the purpose of a roof drain?
9. What methods are used to drain roofs?
10. When must a floor drain fitting with a seepage flange be used?

REFERENCES

1. AFM 85-20, Plumbing
2. National Plumbing Code

WASTE ROUGH-IN FOR LAVATORIES

OBJECTIVE

The objective of this study guide is to assist you in identifying the methods of installing waste lines for lavatories.

INTRODUCTION

When installing small plumbing jobs, you may not have blueprints available, or the blueprints may not show the routing of the piping for the drainage system. If this occurs, the plumber needs to develop a working drawing. To design the waste line for a lavatory system requires good planning to ensure proper operation.

LAVATORY DRAINAGE SYSTEMS

Lavatories are used as depositories for much objectionable waste matter, therefore, the drain may become clogged frequently. The minimum diameter of pipe which may be used as a waste for this fixture is 1 1/4 inches, but it has been found that 1 1/2 to 2 inches works more satisfactorily.

The location of waste pipe used for lavatories must be determined before the stack is installed. This will ensure the proper relation of waste inlet fittings in the stack to the proposed location of the lavatories. Some of the more common types of drainage systems for lavatories will be discussed in this study guide.

In most one-story plumbing installations, the lavatory will drain through a waste pipe into the soil or waste stack. In installations where the lavatory waste trap is to connect directly into the stack with a short nipple, no additional vent is necessary.

In multistory buildings, where lavatories are located on each floor, they should not be drained through a single stack unless each lavatory is individually vented.

NOTE: Vents for lavatories will be discussed in the next study guide. If the drains for the lavatories were connected to the same stack, without the proper venting, the velocity of the drainage flow from the upper lavatory could siphon the trap of the lower lavatory allowing sewer gas to enter the building. Also, a stoppage below the lower lavatory would cause an overflow at the lower trap from the drainage of the lavatory above (see figure 54).

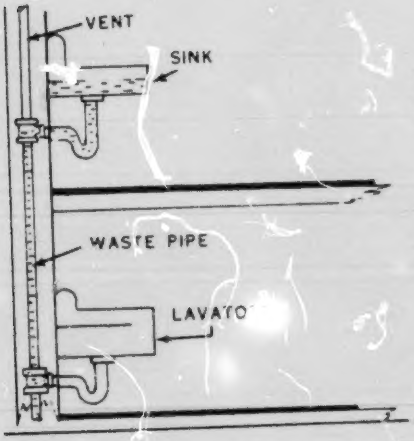


Figure 54. Nonacceptable Drain

Lavatories may be installed in batteries, side-by-side, back-to-back, or individually.

Change in direction of the waste line should be made in the same manner as a change of direction in the soil pipe. It is unwise to use fittings of short radius on horizontal, or vertical to horizontal lines. These must be made with long sweep fittings. Fittings such as a "Y" and 45-degree drainage ell are used to accomplish a turn of this kind.

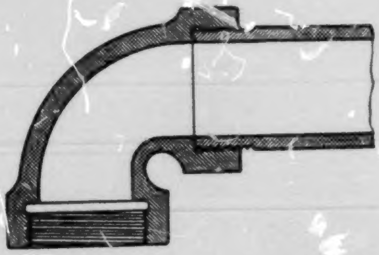


Figure 55. A Recessed Drainage Fitting

When a drainage system requires threaded piping, recessed/drainage fittings are used. A drainage fitting is recessed to allow the inside of the pipe and fitting to butt together to form a smooth inner surface at the joint (see figure 55). These fittings are also tapped so that the turn is slightly less than 90 degrees to allow the pipe to have a pitch of 1/4 inch to the foot.

When roughing-in a lavatory drain, you should refer to the working drawing as you make the installation. The materials that can be used are copper, brass, plastic, galvanized, cast-iron pipe and fittings of any other materials authorized by codes.

The rough-in height for lavatories will vary because of the different shapes that the manufacturers produce, therefore, it is necessary to refer to the manufacturers rough-in specifications for the drain opening height.

A large amount of failure in the waste pipe system can be attributed to the unwarranted use of fittings. There are many plumbers who build an installation piecemeal and do not hesitate to use an extra fitting to help them out of difficulty. Stoppage of the waste lines under these circumstances are common and it is always a reflection on the plumber who installed the system. Fittings are intended to make changes in direction, turns and offsets but their use must be planned carefully so that the waste can flow freely. Sanitary tees are most commonly used in stacks to allow the takeoff of soil and waste branches, because they offer little resistance to flow.

SUMMARY

Lavatories usually drain through a waste pipe into a soil or waste stack. Changes in direction should be made with long sweep fittings. Short turns and the use of improper fittings could cause stoppage in the line, therefore drainage fittings should be used. The rough-in height for lavatory drains will vary. Because of this fact, refer to the manufacturer's rough-in specifications to be sure the rough-in height is correct.

1. What is the minimum size drain for a lavatory?
2. When is a vent not required for a lavatory?
3. What is the purpose of using long sweep fittings for lavatory drains?
4. What type of materials can be used on lavatory drains?
5. What causes a variation in rough-in height?
6. Where does a lavatory drain to?
7. What is the degree of pitch on a threaded drainage fitting?
8. Other than specifications, what controls the selection of materials that can be used for a lavatory drain?
9. What could cause a loss of trap seal?
10. How may lavatory fixtures be installed?

INSTALLATION OF BACK VENTS

OBJECTIVE

The objective of this study guide is to assist you in identifying the construction features and application of vent systems for lavatories.

INTRODUCTION

The size of vents and the method of installation are important to assure proper operation of the drainage system of the lavatory. The diameter of vent piping, as well as the length, depends on the number of fixtures and the types of fixtures served.

LAVATORY VENTING

When a single lavatory is installed in a remote section of a building an individual vent may be constructed to accommodate that lavatory. The lavatory trap is connected directly to the vertical waste and vent as shown in figure 56. The vertical waste pipe may discharge directly into the building drain or a soil or wastepipe or it may change direction below the floor and run horizontally to discharge into the building drain.

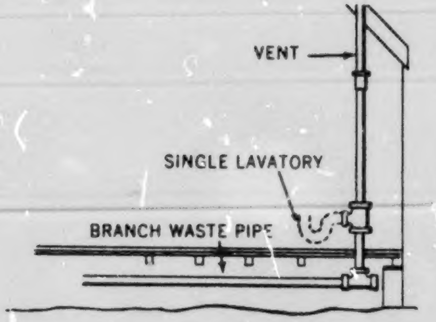


Figure 56. Lavatory, Individual Vent

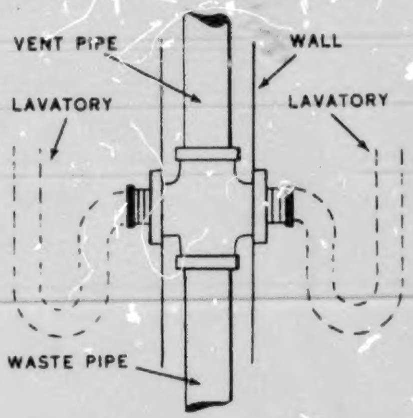


Figure 57. Pair of Lavatories, Unit Vented

Unit Vent

Two lavatories may be installed, either side-by-side or back-to-back, as shown in figure 57. This type of installation is called a unit or dual vent if one vent pipe serves the two traps.

Individual or Back Vent

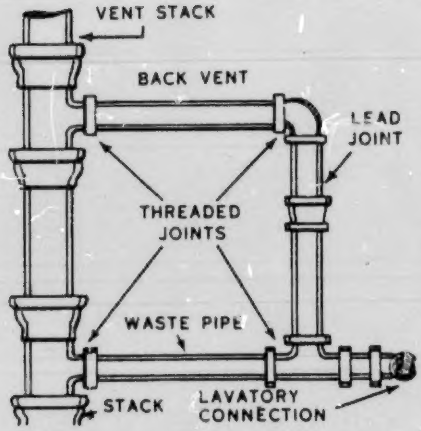

VENT STACK
BACK VENT
LEAD JOINT
THREADED JOINTS
WASTE PIPE
STACK
LAVATORY CONNECTION

Figure 58. Lavatory Back Vent

Whenever a lavatory is located near the stack, as in most small single story residences, the lavatory may be backvented as shown in figure 58.

In multistory buildings, where lavatories are located on each floor and drained through a single stack, it is necessary to use the main vent to individually vent each lavatory as shown in figure 59.

Figure 60 illustrates a wet vent system of venting and draining a lavatory. Notice that the velocity of the drainage flow from the sink of the upper floor has siphoned the trap at the lower lavatory. Note, also, that a stoppage below the lower lavatory would cause an overflow at the lower trap from the drainage of the sink above. Wet venting is not acceptable for lavatories and should be avoided at all times (see figure 60).

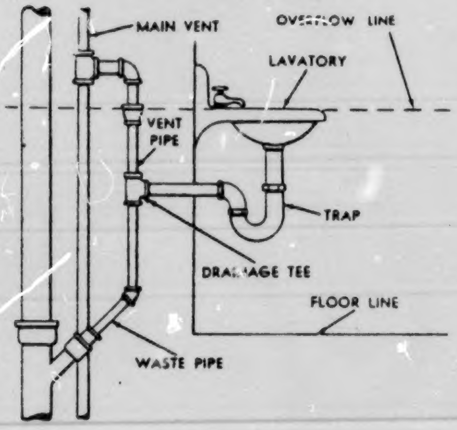

MAIN VENT
OVERFLOW LINE
LAVATORY
VENT PIPE
TRAP
DRAINAGE TEE
FLOOR LINE
WASTE PIPE

Figure 59. Lavatory Individually Vented (Dry venting method)

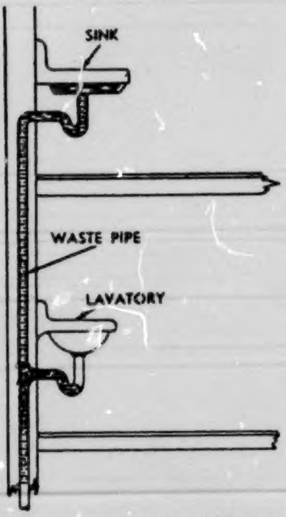

SINK
WASTE PIPE
LAVATORY

Figure 60. Nonacceptable Vent and Drain (Wet venting method)

There are times when drainage and vent systems are constructed of pipe requiring threaded joints. Threaded fittings are usually of two general types, recessed fittings (Durham System), and pressure fittings.

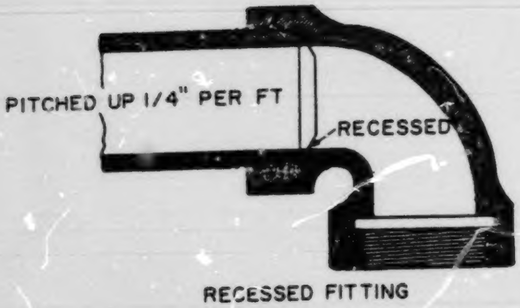


Figure 61A. Recessed Fitting

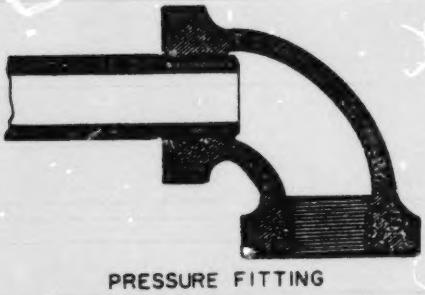


Figure 61B. Pressure Fitting

RECESSED FITTINGS. When the threads are tapped into the fittings they are tapped deep into the shoulder of the fitting. The reason for recessing the threads is to bring the walls of the pipe and fittings flush with each other to avoid the projecting pipe shoulder, which could form a place for accumulation of string, lint and other foreign objects in the waste line that could result in line stoppage. Recessed fittings should be used on all drainage lines where threaded joints are used. A second feature of drainage fittings, which is not found in other types of fittings, is that all 90-degree drainage fittings are tapped to incline the branch pipe 1/4 inch per foot, figure 61A. This permits the drainage water to flow by gravity.

PRESSURE FITTINGS. The pressure fitting is a standard fitting used on water piping. These differ from drainage fittings and the distinction should be carefully noted. Pressure fittings can be used in a dry vent portion of the system but cannot be used in the drainage system, see figure 61B.

IDENTIFYING, MEASURING, CUTTING, AND REAMING PROCEDURE

The pipe used to construct waste and vent lines for a lavatory is cast-iron, plastic, galvanized steel, or copper.

Measuring Steel Pipe

There are several different methods of measuring steel pipe. Among these are end-to-end measurements, end-to-center measurements and center-to-center measurements as indicated in figure 62. End-to-end measurement is measuring from one end of pipe to the other end including the threads. End-to-center measurements are used when a pipe has a fitting screwed on one end only. Center-to-center measurement is from the center of the outlet on one end, along the pipe to the center of the outlet on the other end. You must always remember the length of the thread on the pipe and the center measurement of the fittings to be used must be considered when determining the length to cut a pipe.

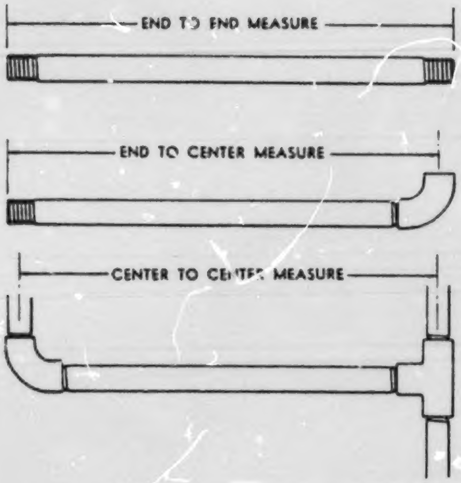

END TO END MEASURE
END TO CENTER MEASURE
CENTER TO CENTER MEASURE

Figure 62. Determining Pipe Measurements

Cutting Steel Pipe by Hand

After the pipe has been measured and marked it should be inserted into a pipe vise where it is held for the cutting operation. Figure 63 shows a piece of pipe in a vise ready to be cut with a pipe cutter. To cut pipe with a pipe cutter, open the jaws of the cutter by turning the handle counterclockwise. Then place the pipe cutter around the pipe at the mark where the cut is to be made. One revolution must be made around the pipe to make a complete cutting mark before turning the handle clockwise again to cut the pipe, if not the cutter will make spiral marks around the pipe instead of marking one complete circle. Figure 64 shows a pipe cutter ready to make the first turn on the pipe to be cut.

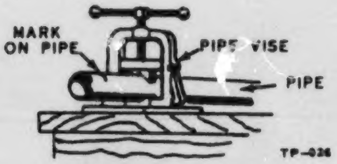

MARK ON PIPE
PIPE VISE
PIPE

Figure 63. Pipe Vise

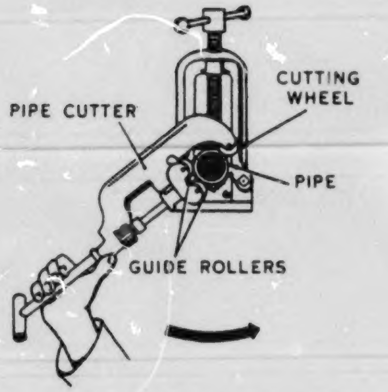

PIPE CUTTER
CUTTING WHEEL
PIPE
GUIDE ROLLERS

Figure 64. Cutting a Pipe with a Pipe Cutter

After at least one complete turn has been made, the handle of the pipe cutter can be turned one-fourth turn to take another "bite" on the pipe. These steps can be repeated until the pipe has been cut off. Figure 65 shows a cutaway of a piece of pipe and the result when using a pipe cutter. "A" shows how the cutter causes a burr to form within the pipe, and "B" shows a cross section of the burr after the pipe has been cut off. This burr must be removed before the pipe is installed, since it hinders the flow of liquids and gases in a pipe.

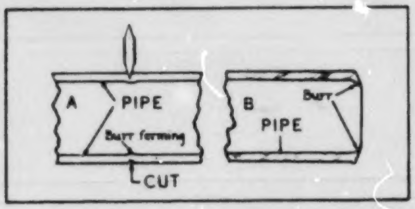


Figure 65. The Result of Cutting Pipe with a Pipe Cutter

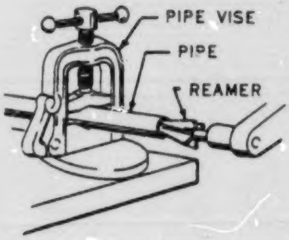


Figure 66. Pipe Reamer

Even with the flush surface obtained with drainage fittings, more trouble is experienced from the lodgement of solid matter than with soil-pipe fittings. For this reason, special care should be taken in cutting the steel pipe to remove all burrs by reaming. The burr is removed from the end of the pipe with a pipe reamer as shown in figure 66. This operation is accomplished by inserting the pipe reamer into the pipe while the pipe is still clamped in the vise. The handle on the reamer is rotated clockwise in short even strokes until the burr on the inside of pipe has been completely removed. Caution should be taken not to overream the pipe. Ream the pipe before threading the pipe.

PIPE-THREADING PROCEDURES

After a piece of pipe has been properly cut and reamed, it can be threaded by hand or with power tools.

Threading Steel Pipe by Hand

A stock and die set of the nonadjustable ratchet type may be used to cut threads on pipe by hand. The nonadjustable ratchet dies, shown in figure 67, can be used to cut threads on pipe from 1/8 inch to 2 inches in diameter by changing to the correct size diehead.

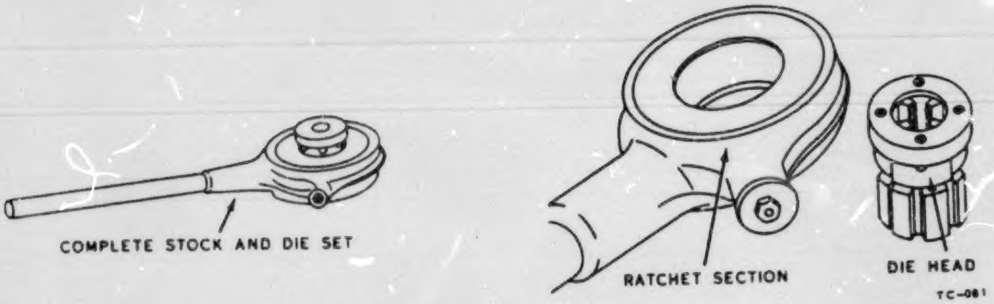

COMPLETE STOCK AND DIE SET
RATCHET SECTION
DIE HEAD
TC-081

Figure 67. Nonadjustable Pipe Dies and Stock

Before threading a pipe, inspect the dies to see that they are sharp and free from nicks and wear. Next, insert the pipe into the vise, place the round guide end of the pipe die stock on the pipe as shown in figure 68, and push the pipe dies against the pipe with the heel of the hand. Exert considerable pressure with the heel of the hand against the pipe. Caution, gloves must be worn during threading procedures to prevent injury to your hands. Exert considerable pressure with the heel of the hand against the pipe die stock and take three or four short clockwise strokes, with the handle of the die stock, to start the thread-cutting operation. After the dies have started, continue with clockwise strokes on the handle, as shown in figure 69, with an even and steady pressure until approximately two threads project beyond the die segments.

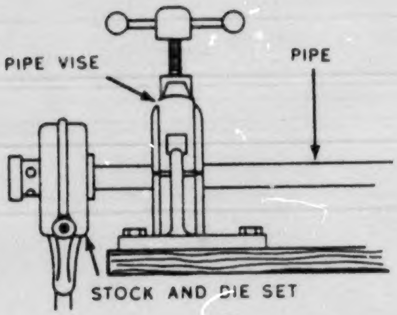

PIPE VISE
PIPE
STOCK AND DIE SET

Figure 68. Placing Die Stock on Pipe

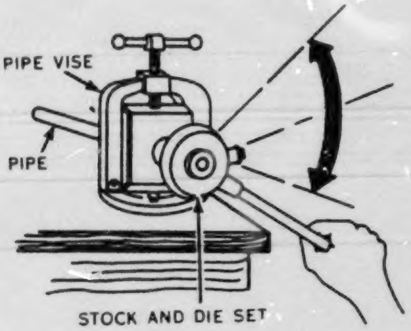

PIPE VISE
PIPE
STOCK AND DIE SET

Figure 69. Threading Pipe with a Ratchet Die

NOTE: To cut clean threads for watertight and airtight joints, the pipe threading dies must be oiled after each two or three strokes with a good grade of lard or sulphur pipe thread cutting oil. The oil prevents overheating and chipping of the dies and marring of the threads.

When the proper number of threads are cut on the pipe, reverse the ratchet on the die stock for counterclockwise operation and make several short motions backward and forward with the handles of the stock to loosen the burrs which are inside the dies. Continue to turn the handle of the stock counterclockwise until the dies are free of the threads.

CAUTION: Many plumbers have a habit of spinning the pipe die stock rapidly to speed the removal of the dies from the pipe. While this may not be injurious to the pipe thread, extreme care must be exercised when spinning the stock to prevent it from striking the legs of the vise or causing an injury to the plumber.

Cutting and Threading Pipe with Power Equipment

Power tools are also available but will normally be used only when large piping systems need to be fabricated. A more detailed discussion on the use of power tools will be given in a later lesson--"Steel Pipe Assembly."

Threading Chromium-Plated Pipe

To prevent scratching or marring chromium-plated pipe during threading procedures, special care must be taken to prevent marring pipe with tooth marks from holding tools, such as vises or chucks. Figure 70 shows two types of clamps which may be used to prevent marring.

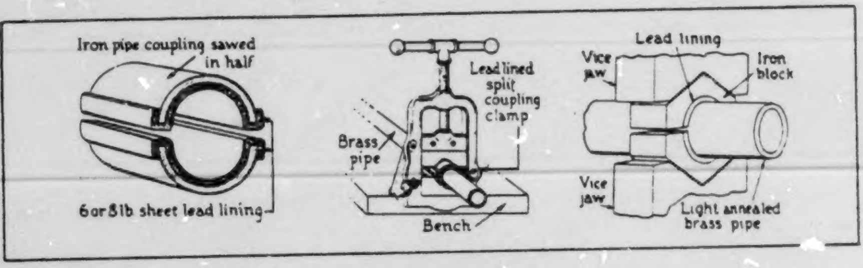

Iron pipe coupling sawed in half
6or8lb sheet lead lining
Lead lined split coupling clamp
Brass pipe
Bench
Lead lining
Vice jaw
Iron block
Vice jaw
Light annealed brass pipe

Figure 70. Clamps Used to Hold Brass or Copper Pipe in a Vise or Chuck

THREADED FITTINGS USED IN LAVATORY DRAINAGE SYSTEMS

When fabricating a loop or circuit with threaded pipe and fittings, the final connection cannot be made with a regular threaded fitting. Pipe unions are designed for a connection of this type but plumbing codes will not permit a union to be used in concealed drain or vent piping.

A special sleeve coupling known as a "Tucker" fitting, illustrated in figure 71, is recommended to make the final connection in a loop of pipe. This special fitting is designed with a female thread on one end, for screwing on threaded pipe, and a bell on the other end for slipping over the other pipe so a leaded joint can be made. The bell is extra deep to allow the pipe to drop down far enough so the other end of the pipe can be screwed into a fitting.

All horizontal vent pipes should be installed with a fall of 1/4 inch to the foot so that moisture can drain by gravity flow into the stack or waste line. Screw-type drainage fittings should be used, rather than regular fittings, because these fittings are recessed, as illustrated in figure 72, and are tapped with a pitch of 1/4 inch to the foot.

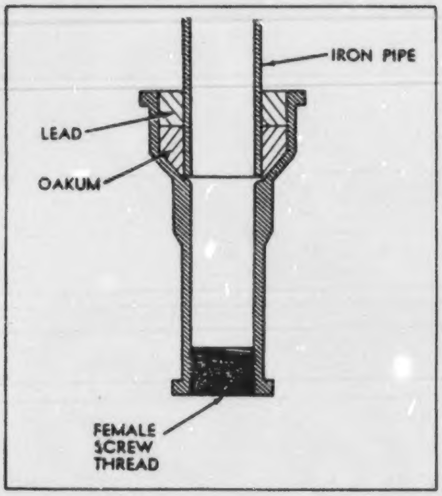


Figure 71. Tucker Connection

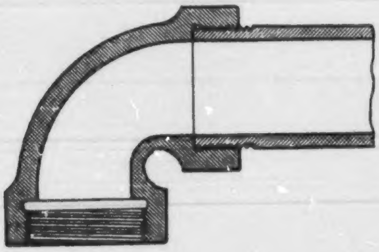


Figure 72. A Recessed Fitting

ASSEMBLING PROCEDURES FOR LAVATORY DRAINS AND VENTS

When roughing in a lavatory, you should refer to the working drawing as you make the installation. The individual fixture vent pipe can be installed with galvanized, copper, or plastic pipe and fittings. Drainage-type fittings, which have a sweeping effect, should be used, rather than regular fittings. A drainage-type fitting will offer less resistance to the flow of liquid or movement of air at points where the direction of the pipe changes.

There are several reasons for using pipe joint compounds. They may be used as a lubricant, a sealing agent, a corrosive protective agent, or as an antiseize compound. The antiseize compound is used in case the joints must later be disassembled. Before making a threaded pipe joint, the male threads should be coated with a pipe joint compound.

Figure 73 illustrates the application of pipe compound to a pipe. Pipe dope is not intended to make up for poor threads or workmanship.

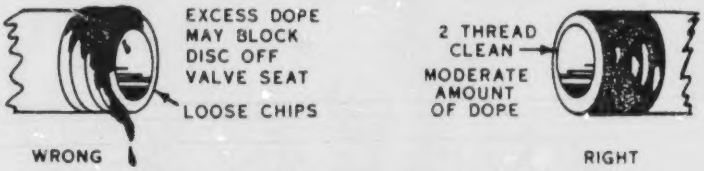


Figure 73. Applying Pipe Compound to a Pipe

Making up Joints

A precaution to observe when making pipe joints is the crossing of threads. Use the proper pipe wrench to screw fittings on the pipe until the desired tightness is obtained. Caution should be used not to overtighten fittings.

SUMMARY

Lavatories usually drain through a waste line into the soil waste stack and are vented into the vent stack. Lavatory waste and vent pipes must have a fall of 1/4-inch per foot. All trap connections which extend through a wall must be of sufficient length for connecting the trap after the finished wall is installed. A backing board for hanging the lavatory should be installed between the studs at the time the rough-in pipes are installed.

Cutting, reaming, and threading pipe are common operations performed daily by plumbers. These operations may be accomplished either by hand or with power tools.

Pipe may be cut either by the use of a standard pipe cutter or a hacksaw. Cutting pipe with a pipe cutter is the preferred method. Cutting with a pipe cutter will cause burr to form on the inside of the pipe. This burr must be removed, since it hinders the flow of liquids and causes stoppages. The time to remove it is immediately after the pipe is cut. A pipe reamer is used to remove the burr.

After the pipe is reamed, it may be threaded by the use of various types of threaders. Threading may be accomplished with either hand tools or power tools. Plenty of cutting oil should be used during the threading operation to keep the die segments cool and prevent them from chipping.

QUESTIONS

1. Where would a "Tucker" fitting be used in a circuit vent or back vent?
2. What fall is given vent or waste lines when they are installed?
3. What two methods may be used to cut pipe? Which is preferred?
4. Why is it necessary to ream pipe before it is threaded?

5. How is pipe reamed?
6. What equipment is used to cut threads on pipe?
7. Why is cutting oil used during a thread-cutting operation?
8. How do you know when the proper thread length has been reached?
9. Why is a lead sleeve used to hold brass, copper, or chromium pipe in a vise?
10. How tight should a fitting be screwed on a thread?

REFERENCES

1. AFM 85-20, Plumbing
2. TO 40F-1-121, Plumbing and Pipefitting

TF- 75-830

173

ROUGH-IN FOR URINAL DRAINS

OBJECTIVE

The objective of this study guide is to assist you in identifying methods, procedures, and materials used in constructing waste lines and vents for urinals.

INTRODUCTION

The Air Force plumber will probably have more service calls to remove stoppages from urinal soil piping than on any other single fixture. These stoppages are caused by cigarette butts, chewing gum and other trash which is thrown into the urinals by thoughtless users. Proper installation of the urinal and its vent will greatly decrease the danger of stoppages. This subject will be covered under the following main topics:

URINAL VENTING AND DRAINAGE METHODS

The installation of vents and waste pipes for urinals is similar to that for other fixtures. Be sure to procure a blueprint or working drawing for locating the urinal and the rough-in measurements for the urinal to be installed. Remember that some urinals are designed with built-in traps while others are not.

The waste and vent lines for urinals are very similar in design and construction as those for lavatories. The type of urinal to be installed will determine the design of the waste and vent systems. There are four basic types of urinals. They are the trough, the stall, the wall hung, and the pedestal.

Urinals will have either a washdown or siphon-jet flushing action. The washdown type will usually have an external trap while the siphon-jet has an integral trap built into the fixture. Figure 74, page 56, shows a cross section of both types of urinals. In the washdown type, the bowl does not carry a body of water to dilute the urine which remains in the bowl unless it is flushed after each use. Urine that is not always washed out of the bowl gives off an offensive odor. This condition is overcome in the siphon-jet type urinal. A large body of water in the bowl immediately dilutes the urine as it enters the bowl.

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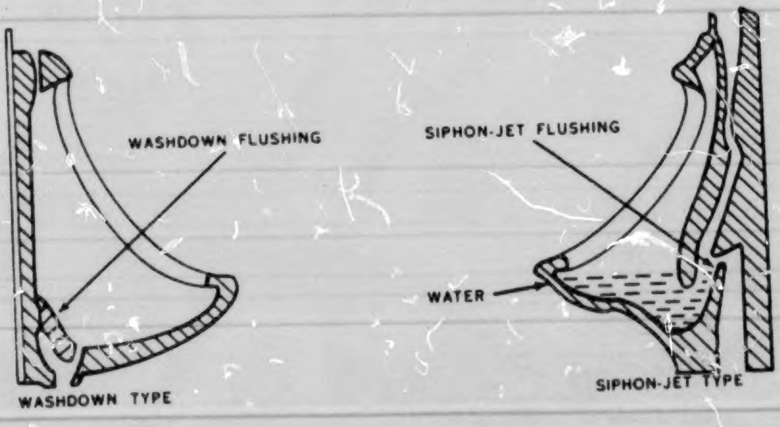

WASHDOWN FLUSHING
WASHDOWN TYPE
SIPHON-JET FLUSHING
WATER
SIPHON-JET TYPE

Figure 74. Types of Wall Hung Urinals

Two-inch soil pipe and drainage tee is the minimum size permitted for draining an individual urinal. Due to the high acid content of urine, the drain system should be fabricated from either copper, plastic or cast-iron pipe and fittings. Galvanized steel, cast iron, copper or rigid plastic pipe and fittings may be used to construct the urinal vent system.

The rough-in plumbing for a battery of wall hung urinals, which have a washdown flushing action, should be installed as shown in figure 75. Each trap is individually vented into a circuit vent. The circuit vent in turn is vented either through the roof or to a main vent.

The rough-in plumbing for a battery of urinals which have a siphon-jet flushing action should be installed so that the urinals will be dual vented as shown in figure 76. The short run of horizontal soil pipe from the fitting on the vertical waste pipe to the fixture trap will enable the siphon-jet flushing action of the urinal to operate more efficiently.

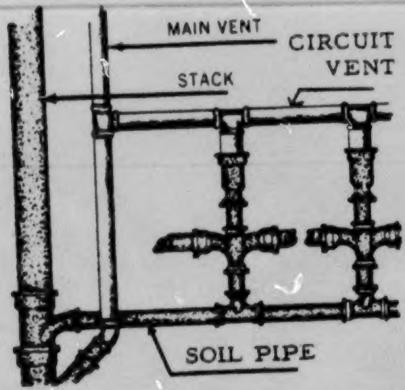

MAIN VENT
CIRCUIT VENT
STACK
SOIL PIPE

Figure 75. Dual/Unit Venting of Siphon-jet Urinals

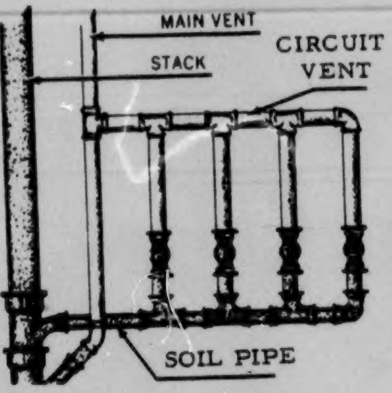

MAIN VENT
CIRCUIT VENT
STACK
SOIL PIPE

Figure 76. Individual Venting of Washdown Urinals

175

When a single urinal is to be installed, as in a restroom, the procedure depends upon the type of urinal. If a washdown type urinal is installed, it should be individually vented and the fixture may be connected directly into a fitting on a vertical soil pipe.

When a siphon-jet urinal is installed, a short run of horizontal soil pipe should be placed between the fitting on the vertical soil pipe and the fixture, as shown in figure 77. The siphon flushing action will be more efficient in operation when the fixture trap does not discharge directly into a vertical soil pipe.

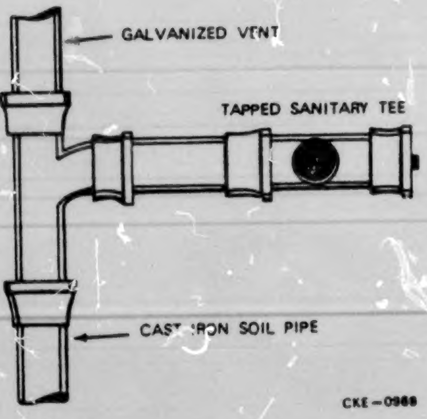


Figure 77. Vent and Drain for Single Siphon-Jet Urinal

Some plumbing codes will permit venting of as many as eight urinals into one circuit vent. Individual or dual venting into a circuit vent is the practice recommended for wall-hung urinals. This practice could prevent many stoppages in the soil piping.

Circuit venting of pedestal type urinals, like the one shown in figure 78, is permitted when the urinals discharge directly into a horizontal soil pipe.

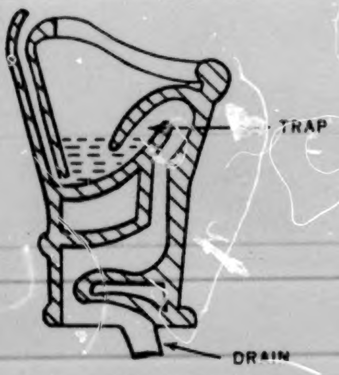


Figure 78. Pedestal Type Urinal

LOCATION AND ASSEMBLY OF URINAL DRAINS AND VENTS

The plumber should consult the blueprint or working drawing to determine where to locate the urinal before roughing-in soil and vent lines. The plumber will also need to consult the manufacturer's rough-in specifications for the exact installation measurements.

Figure 79 shows a manufacturer's rough-in specification sheet for an integral trap wall hung urinal. Notice the drain must be positioned exactly as indicated by the rough-in specifications to insure that lip of the urinal will be at the proper height. There is no flexibility in the measurement since the urinal has an integral trap.

For urinals having external traps, some variation in measurement is permissible due to the length of the tailpiece or the type of trap to be used.

Cast-iron soil pipe can be used for fabricating the soil line to a urinal. The pipe and fittings are installed before the vent lines. The joints are calked with oakum and lead to make a gastight and watertight seal. All soil lines are installed with a fall of 1/4 inch to the foot.

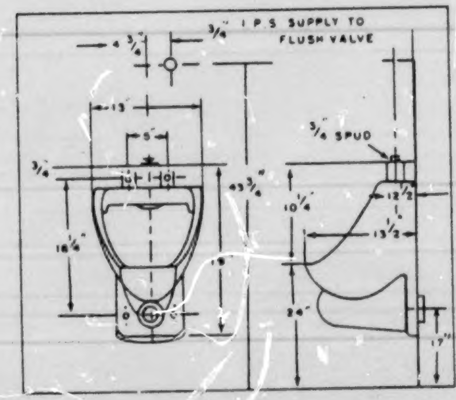


Figure 78. Manufacturer's Rough-in Specification Sheet for a Wall Hung Urinal

The vent lines may be fabricated from galvanized pipe and drainage type fittings. All horizontal vent and drainage lines should be installed with a fall of 1/4 inch to the foot so that moisture can drain by gravity flow into a stack or soil pipe. Drainage fittings are used rather than straight fittings because the inlets of the drainage fittings are tapped with a pitch of 1/4 inch to the foot. This 1/4 inch fall will automatically give the horizontal lines the required drainage pitch, also because they are recessed the drainage line offers little resistance to flow.

Piping must be properly supported to prevent fracture of the piping due to contraction, expansion, and vibration. Piping will be supported at different intervals; this spacing depends on the construction of the piping, its use, and whether it is installed vertically or horizontally.

All pipes or nipples, which are installed to accommodate the urinal traps should be of sufficient length to allow connection of the trap after the finished wall is installed.

SUMMARY

Cast-iron pipe and fittings can be used for constructing the soil piping for urinals. Galvanized pipe may be used for venting. Urinals should be individually vented when possible to lessen the possibility of stoppages in the soil lines. Batteries of washdown type wall urinals should be individually vented into a circuit while siphon-jet urinals should be dual-vented to the circuit. All soil and vent piping is installed with a fall of 1/4 inch to the foot to insure proper drainage. All trap connections which extend through a wall must be of sufficient length for connecting the trap after the finished wall is installed. A backing board for wall hung type urinals should be installed into the building framework at the time the rough-in piping is installed.

QUESTIONS

1. Why are cast-iron pipe and fittings recommended for urinal drainage lines over galvanized pipe and fittings?

2. Why is the siphon-jet urinal considered to be more sanitary than a washdown type?

3. What is the minimum size soil pipe used to drain a urinal?

4. How is the opening for a urinal drain located?

5. When installing soil pipe for a urinal, what is the required fall per foot?

6. Name two types of flushing actions for urinals.

7. Name four types of urinals.

8. What type of venting system should a series of siphon-jet urinals have?

9. What is the maximum number of fixtures on one circuit vent?

10. What type of pipe can be used for a urinal vent?

REFERENCES

1. AFM 85-20, Plumbing

2. National Plumbing Code Handbook, Vincent T. Manas

ROUGH-IN FOR SHOWERS AND TUB DRAINS

OBJECTIVE

The objective of this study guide is to assist you in identifying procedures and materials used in shower and tub drain rough-ins.

INTRODUCTION

The installation of waste branches for draining bathtubs and showers is very similar to installing the waste branches for other fixtures. Quality workmanship is necessary to insure proper operation of the drains with a minimum of maintenance. The trap is included in the rough-in plumbing for a tub or shower and the type of trap used will partially determine the design of the vent piping.

SHOWER AND TUB DRAIN CONSTRUCTION

Don't guess or redesign engineering plans. Follow the manufacturer's rough-in specifications when installing fixtures. These specifications contain exact measurements for piping for the fixture to be installed.

For the sake of familiarity, the following illustrations, figures 80, 81, 82, and 83 show four shower installations.

Waste lines are normally located below the floor of the shower and discharge into stacks.

When a single shower stall is to be installed, the rough-in waste pipe should be a minimum of 2 inches in diameter. A shower room, with a gang of shower heads such as those used in the Air Force buildings where personnel are quartered, will require a waste pipe of three or four inches in diameter. This will handle the high volume of flow during peak periods of use.

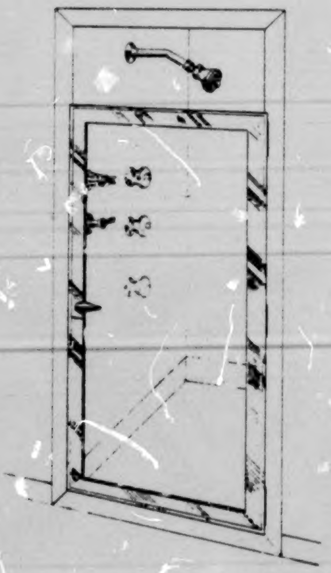


Figure 80. Recessed Shower (Single Drain)

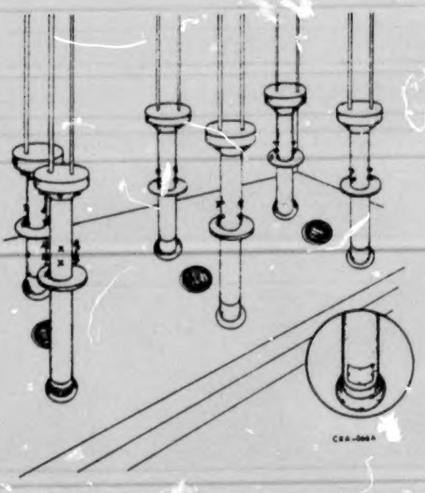


Figure 81. Gang Shower

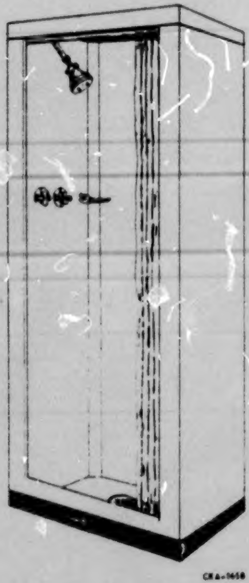


Figure 82. Cabinet Shower (Single Drain)

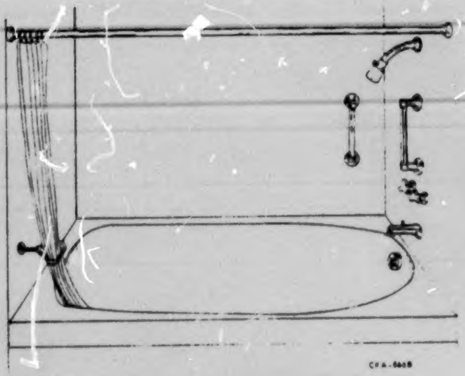


Figure 83. Tub and Shower Combination (Single Drain)

The most important requirement in a shower installation is the absolute waterproofing of the walls and floors. Walls are less of a problem than floors since they are subject only to the splashing of water. Careful installation of tile or other impervious material with waterproof cement, generally suffices to provide a waterproof wall installation.

In the installation of the floor, it is necessary to provide a waterproof subbase under the shower floor. Water standing on the floor can gradually seep through it and cause leaks. Figure 84 shows the installation of one type of shower drain. This drain is constructed with a lead pan under the shower floor to guard against water seepage. When installing a shower drain of this type, the general outline of the shower stall should be roughed in to provide a solid base of subflooring or plywood on which the lead shower pan will rest. This wood flooring is absolutely necessary since the lead pan is soft and pliable. If it is not supported properly, it will sag under the weight of the tile or other shower floor material, thereby causing a leak.

The lead pan is constructed by using a solid sheet of lead approximately six to eight inches larger than the size of the shower floor and bending up the edges at right angles to the desired height. A hole is cut in the location of the shower drain and the shower pan is lowered into place. It should rest firmly on the seepage flange of the shower drain. Coat the inside of the shower pan with asphaltum. Paint the portion of the lead shower pan under the top of the flange with pipe-joint compound and place a thin layer of putty on it. Place the upper flange on top of the lower flange and screw them together forming a watertight joint between the shower waste and the shower pan. Screw the strainer portion of the shower drain down into the flanges to the desired height of tiling. The installation is completed by laying cement in the shower pan and finishing the floor.

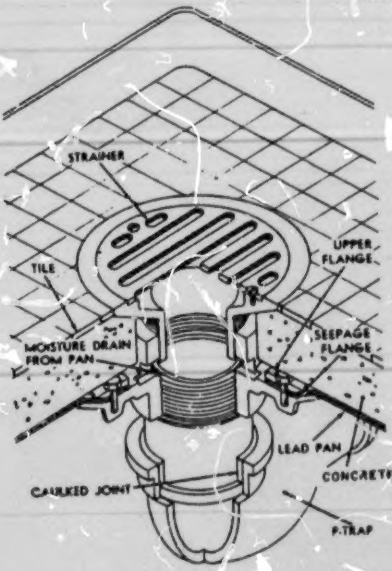


Figure 84. A Shower Drain Showing Lead Pan

Shower drain traps seldom cause trouble. They normally have relatively clear water flowing through them. The only major problem is the removing of hair which is usually caught by the strainer.

Shower drain and floor drain systems are very similar in design and construction. Floor and wall preparation is the same. The floor drain and trap are the only items that may differ.

Another fixture requiring a floor drain is the bathtub. The bathtub, having a shower in combination with it, becomes the shower base and requires no special floor preparation. The tub drain and trap connections may differ somewhat.

As was pointed out earlier in this text, the waste rough-in must comply with the manufacturer's rough-in specification for the fixture being installed. The following illustration depicts good reason for following specifications especially where bathtubs are used in combination with showers.

Notice that one bathtub has the drain on the left-hand side (figure 85), while the other has the drain on the right-hand side (figure 86).

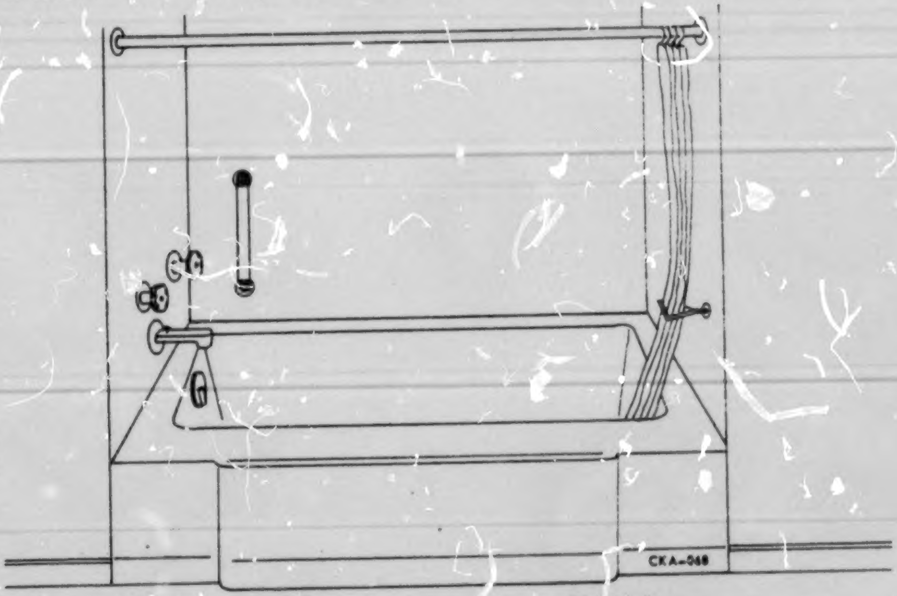


Figure 85. Recessed Type Bathtub

CR. 75-810

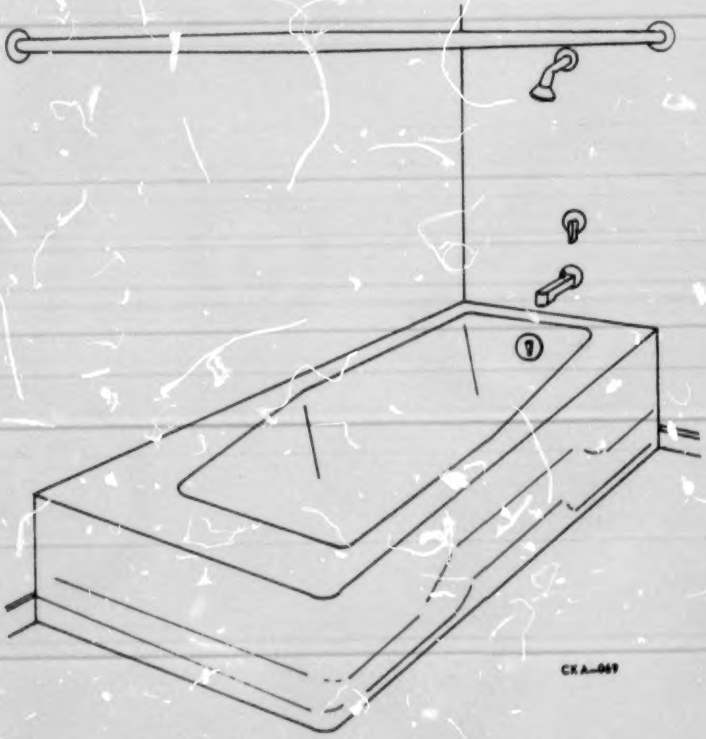


Figure 86. Corner-Type Bathtub

Waste lines for bathtubs are normally located below the floor level. In small residential bathrooms, the waste lines and fixtures are placed to insure use of common pipes and vents (see figure 87). The rough-in plumbing does not include the tub overflow and drain as shown in figure 87. Rather, it is attached to the tub when it is set (installed). The drum trap or P-trap would be installed with the rough-in as shown in figure 87. The minimum size waste pipe for a bathtub is 1 1/2 inches. It is not necessary to increase the pipe size if a shower head is installed over the tub.

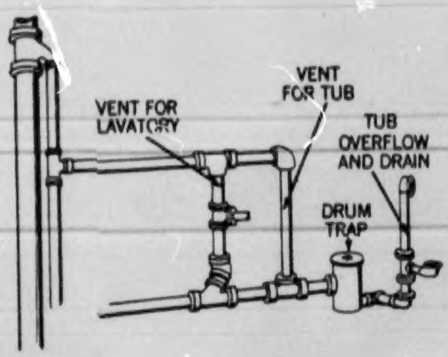


Figure 87. Rough-In Plumbing for Small Bathroom

PURPOSE AND TYPES OF DRAINAGE TRAPS

There are two types of traps used for bathtub and shower installations. They are the P-trap and the drum trap. The P-trap is shown in figure 88. A drum trap is shown in figure 89. When the P-trap is used, the waste pipe must be vented on the outlet side of the trap. The vent should be positioned as close to the trap as practical. An acceptable vent is shown in figure 90.

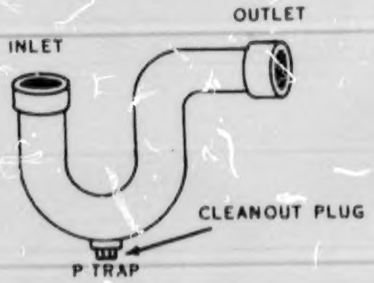


Figure 88. Bathtub P-Trap

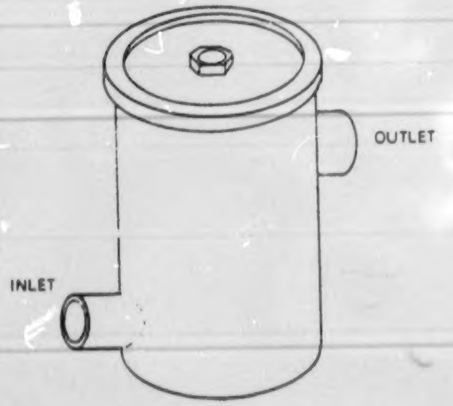


Figure 89. Drum Trap

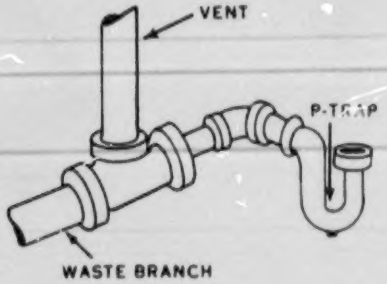


Figure 90. Venting a P-Trap for a Bath

Cast-iron pipe and fittings are used when piping is run under a concrete floor.

If the trap cannot be vented, or is wet-vented through another fixture, the drum trap should be used. The drum trap holds a larger volume of water than does the P-trap. Because of this, it is used where siphonage may be problem. Figure 91 shows a drum trap wet-vented through the lavatory drain.

A drum trap must be installed even with the floor. It is constructed in a manner which allows quick cleaning.

Care must be taken when roughing-in the drain system. Allow for proper placement of the drum trap, the tub overflow and drain (sometimes called the "waste and overflow"), as well as the drain system. If specifications are not followed carefully, much of the original work will have to be reaccomplished to set the bathtub.

Both the pipe and fittings of the waste system may be constructed with cast-iron, copper, plastic, and galvanized steel. Changes in pipe sizes are made with reducing fittings. However, the pipe between the trap and point of discharge cannot be reduced. Slip joints are permitted only in the trap seal or the inlet side of the trap. "Tucker" or hub drainage fittings are used for unions with dry vents. Recessed fittings should be used with screwed connections.

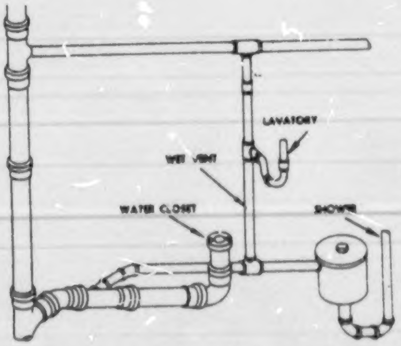


Figure 91. Drum Trap Wet-Vented through Lavatory Waste Piping

Waste pipes from bathtubs usually discharge into the stack. In small residences, where the bath fixtures are grouped in a small room, the waste pipe may discharge into the closet bend as illustrated in figure 92. The fixture traps may then be back-vented into the stack vent.

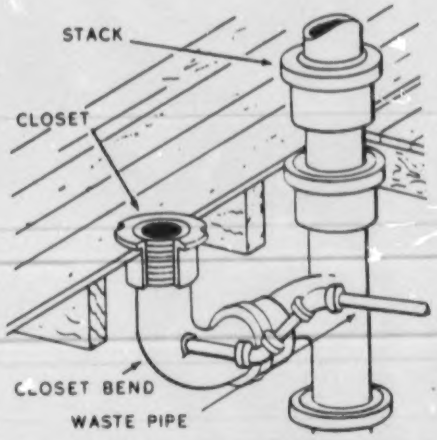


Figure 92. Discharging Bathtub and Shower Waste into Closet Bend

All waste and horizontal vent lines for showers and tubs should be installed with a fall of 1/4 inch to the foot. Waste lines 3 inches in diameter or larger which serve shower may be installed with a patch of 1/8 inch to the foot.

PIPE SUPPORT METHODS

The horizontal waste lines must be supported. They are supported by the building framework or by use of metal hangers. Metal hangers should be made of the same metal that the pipes are made of. This reduces the possibility of corrosion. Special note should be made of the drum trap. It is heavy and requires hangers close to it. When installing hangers, be careful to maintain the proper drop of the waste system.

SUMMARY

Installation of bathtubs should be in accordance with manufacturer's specifications. Tubs are identified by the location of the drain and style. Showers have four classifications; recessed, metal cabinet, gang and tub/shower combinations. A prime problem in the construction of showers in maintaining a moistureproof seal in the floors and walls. Drainage traps used for bathtubs and showers are P-traps and drum traps. The trap is installed as part of the rough-in plumbing. Drum traps are used when dry venting is not practical. The P-trap is preferred when venting and space permit. All horizontal waste pipes require support. A hanger is required near the drum trap and hangers must maintain a proper drop (slope) within the waste system.

QUESTIONS

1. What are the four basic types of showers?
2. What is the minimum size pipe used to drain a bathtub?
3. To which side of the trap is the vent line connected?
4. What is the minimum size pipe used to drain an individual shower stall?
5. When would a drum trap be used?
6. When is a slip joint permitted?
7. Where is a tucker fitting used?
8. What type of fitting can be used in the bathtub drain?
9. Of what material can the waste branch be constructed?
10. Why should the drum trap be supported?

REFERENCES

AFM 85-20, Plumbing

ROUGH-IN FOR WATER CLOSET DRAINS

OBJECTIVE

The purpose of this study guide is to assist you in identifying the methods, procedures, and materials used in roughing in water closet vent and drain systems.

INTRODUCTION

There are many different kinds of water closets. Some are better than others. Regardless of type of water closet, the rough-in must be accomplished in accordance with the manufacturer's rough-in specifications. The drain and vent system must always comply with the plumbing codes.

TYPES OF WATER CLOSETS

Water closets are available in a variety of colors and designs. They are all designed to fulfill the same function. Figures 93 and 94 illustrate two types of water closets. Vent and drain systems will vary depending on where the water closets are located and the number installed.

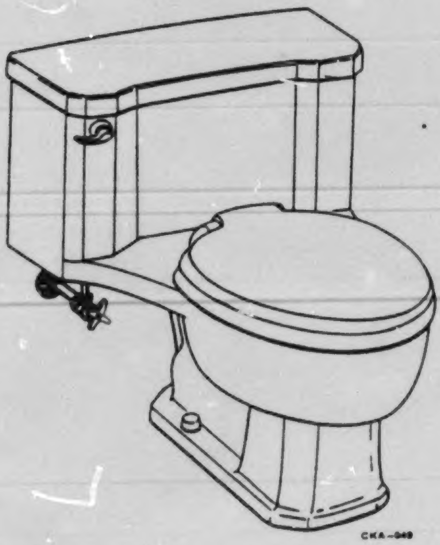


Figure 93. Floor-Mounted Water Closet

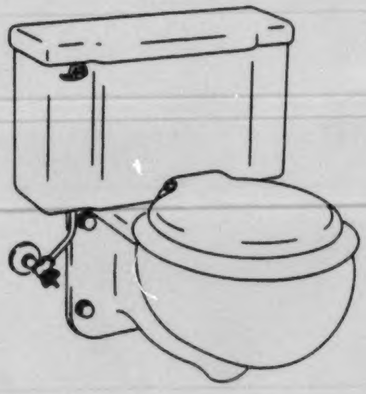


Figure 94. Wall-Mounted Water Closet

DRAIN AND VENT SYSTEM INSTALLATION

Drain Systems

Copper and plastic can be used in construction of drainage systems. A complete selection of copper and plastic fittings are available for use with soil piping. The use of these materials eliminate the need for heavy tools and equipment required for threaded pipe or cast-iron assembly.

Floor-mounted water closets are installed on a flanged collar which attached to a closet bend. Closet bends are available in low and high neck designs and with right, left, top or heel tappings (see figure 95).

Closet bends are used to connect the water closet to the drain system.

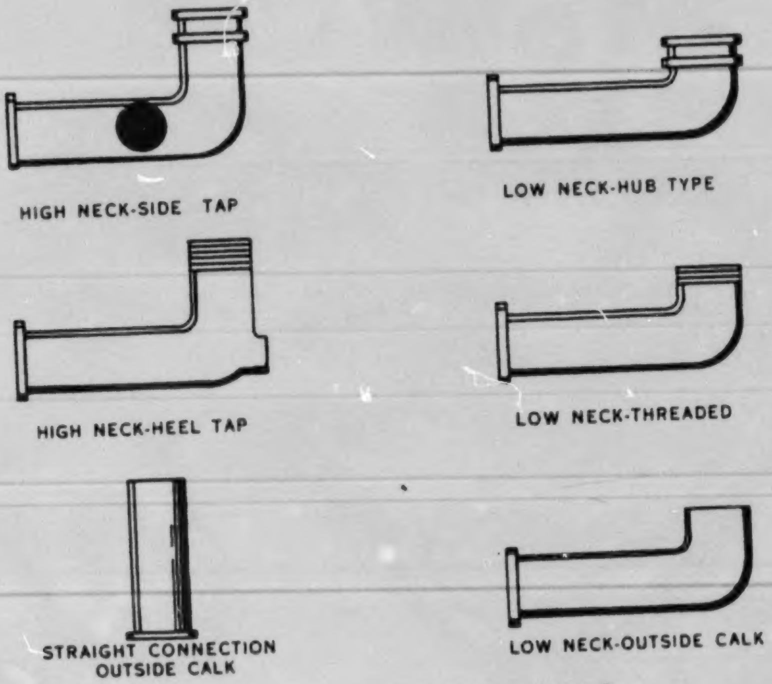

HIGH NECK-SIDE TAP
LOW NECK-HUB TYPE
HIGH NECK-HEEL TAP
LOW NECK-THREADED
STRAIGHT CONNECTION OUTSIDE CALK
LOW NECK-OUTSIDE CALK

Figure 95. Types of Closet Bends

Wall-mounted water closets require a special fitting and mounting bracket. The bracket is called a chair carrier and supports both the water closet and the fitting within the walls. Figure 96 and 97 illustrates two types of chair carriers and fittings.

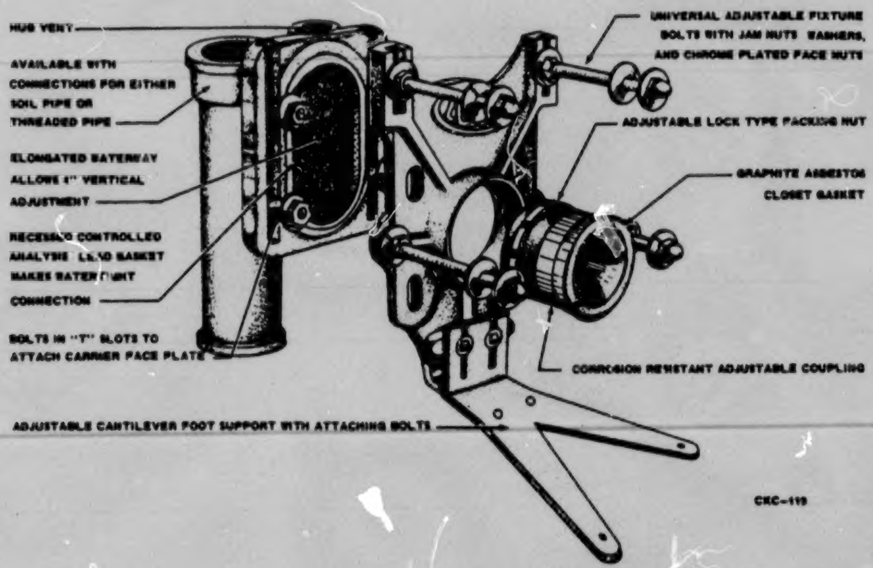

HUB VENT
AVAILABLE WITH CONNECTIONS FOR EITHER SOIL PIPE OR THREADED PIPE
ELONGATED WATERWAY ALLOWS 4" VERTICAL ADJUSTMENT
RECESSED CONTROLLED ANALYSIS LEAD GASKET MAKES WATERTIGHT CONNECTION
BOLTS IN "T" SLOTS TO ATTACH CARRIER FACE PLATE
ADJUSTABLE CANTILEVER FOOT SUPPORT WITH ATTACHING BOLTS
UNIVERSAL ADJUSTABLE FIXTURE BOLTS WITH JAM NUTS WASHERS, AND CHROME PLATED FACE NUTS
ADJUSTABLE LOCK TYPE PACKING NUT
GRAPHITE ASBESTOS CLOSET GASKET
CORROSION RESISTANT ADJUSTABLE COUPLING
CKC-119

Figure 96. Chair Carrier (Vertical)

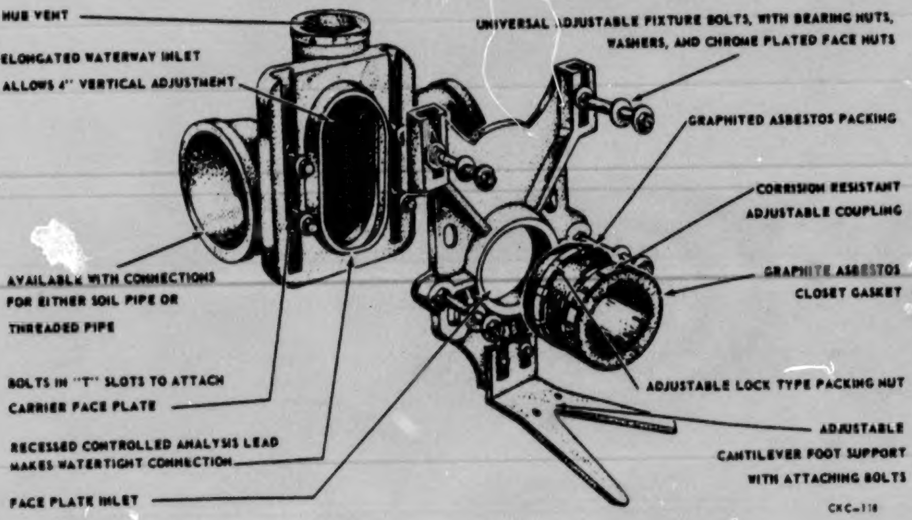

HUB VENT
ELONGATED WATERWAY INLET ALLOWS 4" VERTICAL ADJUSTMENT
AVAILABLE WITH CONNECTIONS FOR EITHER SOIL PIPE OR THREADED PIPE
BOLTS IN "T" SLOTS TO ATTACH CARRIER FACE PLATE
RECESSED CONTROLLED ANALYSIS LEAD MAKES WATERTIGHT CONNECTION
FACE PLATE INLET
UNIVERSAL ADJUSTABLE FIXTURE BOLTS, WITH BEARING NUTS, WASHERS, AND CHROME PLATED FACE NUTS
GRAPHITED ASBESTOS PACKING
CORRISION RESISTANT ADJUSTABLE COUPLING
GRAPHITE ASBESTOS CLOSET GASKET
ADJUSTABLE LOCK TYPE PACKING NUT
ADJUSTABLE CANTILEVER FOOT SUPPORT WITH ATTACHING BOLTS
CKC-118

Figure 97. Chair Carriers (Horizontal)

The flanged collar used in conjunction with the floor-mounted water closet can be referred to as a flanged collar, closet bend collar, floor flange, or closet flange. The flange provides the means for securing the water closet to the floor and the means for a gas- and watertight seal between the water closet and closet bend. See figure 98.

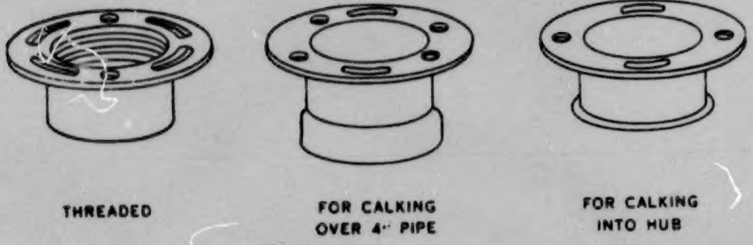

THREADED
FOR CALKING OVER 4" PIPE
FOR CALKING INTO HUB

Figure 98. Closet Bend Collars

Vent Systems

Some plumbing systems are laid out so that the closet bend will discharge directly into the soil stack. If installed in this manner, no additional venting is necessary. See figure 99.

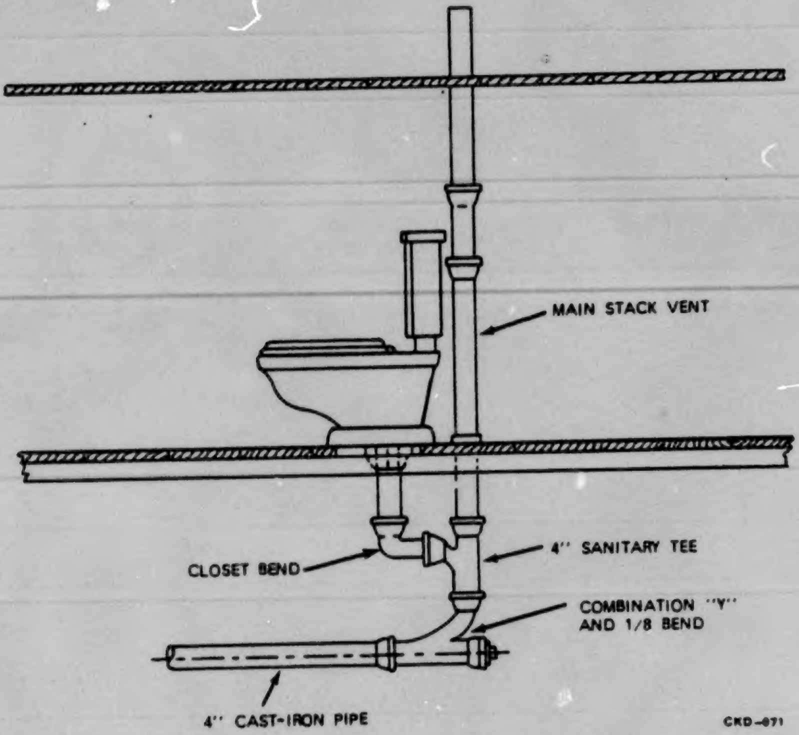

MAIN STACK VENT
CLOSET BEND
4" SANITARY TEE
COMBINATION "Y" AND 1/8 BEND
4" CAST-IRON PIPE
CKD-071

Figure 99. Single Water Closet Installation

Whenever a battery of water closets are to discharge into a horizontal soil pipe, they may be vented as shown in figure 100 or figure 101.

The maximum amount of fixtures allowed in one battery is eight.

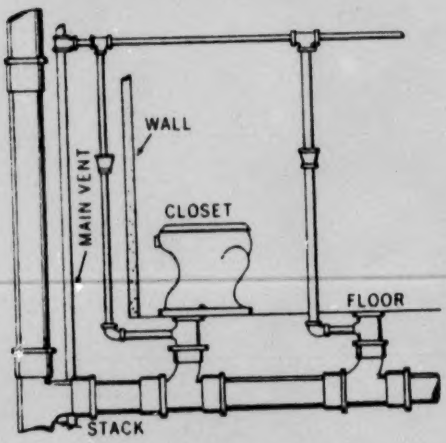


Figure 100. Battery of Fixtures Individually Vented In A Circuit

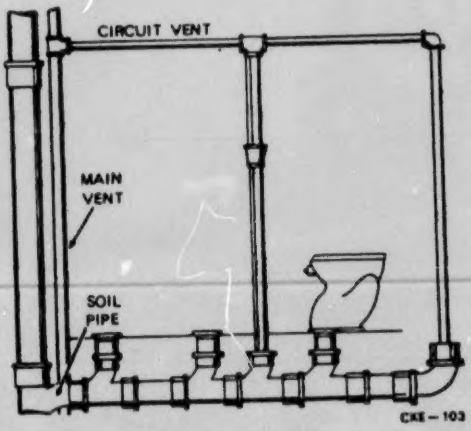


Figure 101. Circuit Vent for Battery of Water Closets

Wall-mounted water closets may also be installed in batteries. Codes specify the number of water closets that may be installed on any single drain system.

Regardless of the number of water closets installed, the system must be vented to function properly. Pipe sizing and vent design is regulated by plumbing codes in accordance with the number of fixtures to be vented.

SUMMARY

The location of the water closets in a structure, as a rule, will govern the location of the soil stack. No additional venting is required when the closet bend discharges directly into a soil stack. A closet flange is attached to the closet bend so the floor-mounted water closet may be secured in place. A chair carrier is used to support both the wall-mounted water closet and fitting connecting the water closet to the drain system.

Codes regulate the number of water closets connected in batteries as well as pipe sizing for both drain and vent systems.

QUESTIONS

1. What is the basic difference between the water closets mentioned in the text?
2. How many water closets can be installed in a battery?
3. What is the fitting called that is used to connect the floor-mounted water closet to the closet bend?

4. What is the purpose of a chair carrier?

5. What determines the type of vent and drain system used on water closets?

6. What are some of the advantages of using copper and plastic?

7. When is it not necessary to install additional vents for water closets?

8. List two types of chair carriers.

9. What determines the size drain to be installed for a water closet?

10. Why must the water closet be vented?

REFERENCES

1. AFM 85-20, Plumbing

2. AFR 127-101, Ground Accident Prevention Handbook

3. National Plumbing Code

TESTING DRAINAGE SYSTEMS

OBJECTIVE

The objective of this study guide is to help you learn the procedures for testing a plumbing drain and vent system and the methods for locating and repairing leaks in the system.

INTRODUCTION

Waste and vent systems are usually installed in walls, ceilings, under floors, or buried in a trench or in the ground; therefore, they must be tested to see if they leak before the carpenter conceals them or before backfilling the trench.

TESTING SOIL PIPE ASSEMBLIES

All new plumbing work and such portions of existing systems as may be affected by new work or any changes will be inspected to insure that all the connections are water-, air-, or gastight.

There are four methods of testing waste systems: water, air, peppermint, and smoke.

Water Test

The water test will be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping will be tightly closed, except for the highest opening, and the system filled with water to the point of overflow. If the system is tested in sections each opening should be tightly plugged except the highest opening in the section under test, and each section should be filled with water. But no section should be tested with less than a 10-foot head of water.

Figure 102 illustrates a test plug which is expanded to seal the pipe by tightening a wingnut. Figure 103 illustrates a test plug which is expanded by a ratchet device.

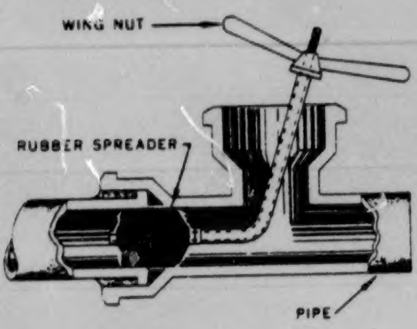


Figure 102. Test Plug

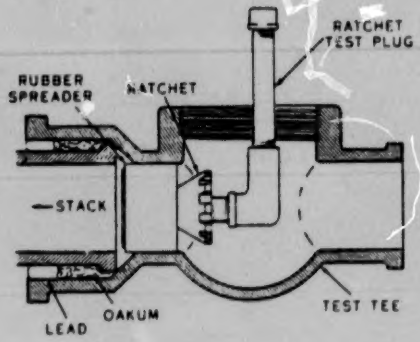


Figure 103. Test Plug with Ratchet Handle

After all the openings have been plugged, fill the system through the highest point with water and allow it to stand for 12 to 24 hours. This allows time for the oakum in the joints to swell and form a watertight seal. After the soaking period, refill the system with water for the testing period. The system must hold this water for 30 minutes without dropping more than 4 inches.

In testing a section of the system not having the roof vent installed, install a vertical temporary vent 10-feet long to perform the test.

When testing a multistory building system, the maximum amount of height that can be tested at a time is five stories. The water pressures caused by a greater height might force the test plugs out of the test tee or separate the joints.

In those parts of the country where temperatures normally drop below 32°F, no water test should be performed during the months of freezing weather. Even if the tests are completed before the temperature goes below freezing and then the temperature drops, there is a possibility of the oakum being saturated with water and the pipe cracking at the hub.

Air Test

Some job specifications require the system to be air tested. To perform the air test, plug all outlets including the vent through the roof. Attach an air compressor testing apparatus, as illustrated in figure 104, to any suitable opening and after checking to see that all openings are sealed off, force air into the system until there is a uniform gauge pressure of 5 pounds per square inch (psi) or sufficient to balance a column of mercury 10 inches in height. The pressure should hold steady, without adding any additional air for a period of at least 15 minutes.

If the pressure drops, apply soapy water to the suspected leaking area. A leak can be detected by bubbles where the solution is applied.

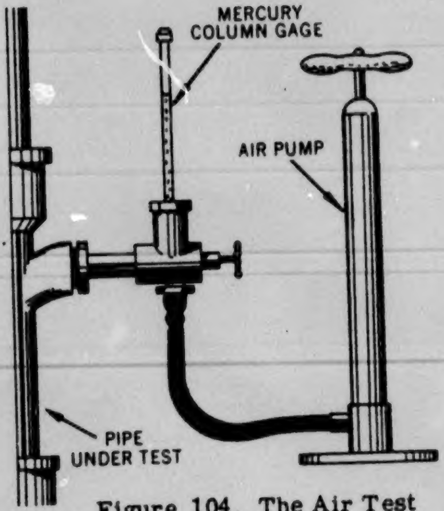


Figure 104. The Air Test

One advantage of the air test over the water test is that the air test gives a uniform pressure over the entire system, whereas in the water test the greatest pressure is at the lowest point. Another advantage is that the air test can be performed when freezing weather prevents the use of water.

An air test is somewhat more rigid than a water test, as it is more difficult to find the leaks unless soap and water are used at the joints, or some odor is injected into the pumped air.

Smoke Test

The water or air test is normally used in testing new work. Old work which has been repaired or modified is usually tested with smoke. To perform the smoke test, close all the openings and force smoke into the system with a smoke machine see figure 105. using 1/2 pound of pressure.

When testing an old system, be sure that all of the fixture traps are sealed with water to prevent smoke from escaping into the building.

The inspector who is to check for leaks should not enter the area where the smoke machine is operating. This is to prevent his becoming accustomed to the odor of smoke so he can locate the leaks easier.

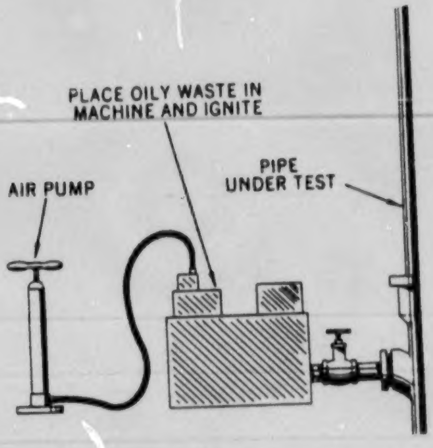


Figure 105. The Smoke Test

Peppermint Test

To make a peppermint test, make certain all traps are filled with water. Pour 2 ounces of oil of peppermint down each vent pipe that extends through the roof. If the building is over five stories high, add an additional ounce of peppermint for each five stories to be tested. After pouring the peppermint, add 5 gallons of boiling water and close the vent to prevent the peppermint odor from escaping.

As with the smoke test, the inspector should remain away from the area until the test is prepared so that he can locate the leaks.

REPAIRING LEAKS

If a leak is found in the system by using one of the tests outlined, usually it is from a faulty lead joint. To repair, recalk the lead with an inside iron and then an outside calking iron as when making the original joint. Most leaks can be repaired by this recalking process. If the leak persists, remove all lead and oakum and reaccomplish the joint.

Use a pick-out iron, as shown in figure 106. to remove the lead and oakum.

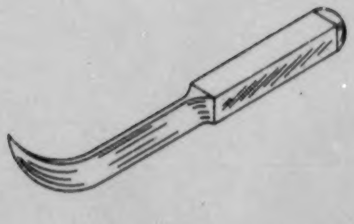


Figure 106. Pick-Out Iron

CAUTION: Be sure to lower the water in the system below the joint before attempting to make the repair. Do not apply heat to melt the lead in the joint because the moisture in the oakum may cause the lead to pop out and injure you.

After removing the lead and oakum from the joint, dry it out by applying heat before attempting to replace the oakum and lead. Never attempt to repair a fitting by welding or brazing--replace it.

A special joint is available for replacing a joint in a run without replacing the whole run. This joint, shown in figure 107, is called an insertable (Sisson) joint.

The spigot end of the insertable joint is calked and leaded into the bell end of a length of pipe that has been shortened. Notice that the hub on the insertable joint is extra deep. This depth allows the last section of pipe to be lowered into the deep hub and then be raised into place. The procedure for replacing a section of pipe is shown in figure 108.

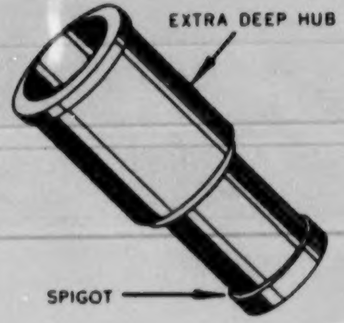


Figure 107. Insertable (Sisson) Joint

When leaks are detected in concealed threaded waste and vent pipe joints, it is usually necessary to remove and reinstall the piping. Never attempt to stop a leak in a threaded connection by tightening the pipe. You may stop the leak at that joint but you may loosen another connection and cause a leak there. The only way to correctly repair a leaking joint is to cut the pipe and install a tucker fitting. Also, do not try to stop a leak by smearing or painting the outside of the joint with a resin compound or paint. This may stop the leak temporarily but it will leak again later.

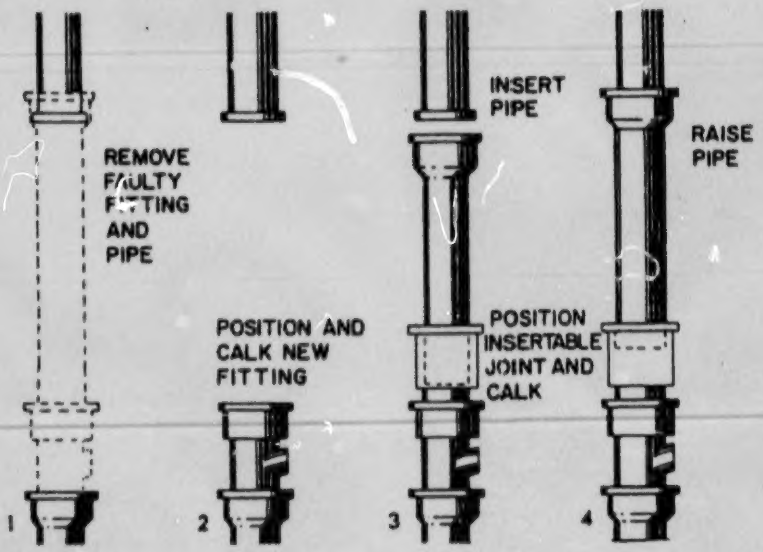

REMOVE
FAULTY
FITTING
AND
PIPE
POSITION AND
CALK NEW
FITTING
INSERT
PIPE
POSITION
INSERTABLE
JOINT AND
CALK
RAISE
PIPE
1
2
3
4

Figure 108. Replacing Pipe by Using an Insertable Joint

The final joint is made with a tucker connection. A tucker connection is similar to the insertable joint except that the spigot end has threads so that one end can be a screwed joint and the other end, a calked joint. Never use pipe unions to repair leaks in waste or vent piping because they will vibrate loose.

During the test, inspect and install or replace all bracing or hangers that may have been removed to perform the test.

SUMMARY

A plumbing system should be tested in sections before they are concealed so that repairs can be made easily. There are four methods of testing: water, air, smoke, and peppermint. To make these tests, all openings must be sealed. Special test plugs are manufactured for this use.

Recalk a leaking lead joint. If it cannot be repaired by recalking, remove the lead and oakum and reaccomplish the joint.

Be sure there is no water in the joint when pouring hot lead as it will pop out and burn nearby personnel.

To eliminate removing the complete piping system, install an insertable joint or a tucker connection when replacing a section.

QUESTIONS

1. What are four methods used in testing waste plumbing systems?
2. Why is a smoke or peppermint test used for the final testing of a waste system rather than a water test?
3. How are leaks located when the air test is used?
4. What advantages does the air or peppermint test have over a water test for a waste system?
5. What determines the type and number of tests which must be made?
6. What is the purpose of the soaking period when making a test?
7. What precautions should be taken when pouring molten lead into a joint after a water test has been made?
8. When is it necessary to use a Tucker connection or an insertable joint to repair leaks?
9. How are leaks located when using a smoke or peppermint test?
10. What precautions should be observed when removing a calked joint from a system for repair?

REFERENCES

1. AFM 88-8, Chapter 4, Plumbing
2. AFM 85-20, Plumbing

198

3-22

WB 3ABR55235- II -1-P1 thru 9-P1

Department of Civil Engineering Training

Plumbing Specialist

BUILDING WASTE SYSTEMS

November 1974

SHEPPARD AIR FORCE BASE

Designed For ATC Course Use

DO NOT USE ON THE JOB

TABLE OF CONTENTS

PLUMBING SPECIALIST

Block II

PROJECT	TITLE	PAGE
3ABR55235-II		
1-P1	Building Drains	1
1-P2	Cutting and Fabricating Four-Inch Cast-Iron Pipe	5
2-P1	Components of Building Drains and Vent Systems	9
2-P2	Fabricating Vents and Stacks	11
2-P3	Grading Pipe	15
2-P4	Attaching Pipe to Building Structure	17
3-P1	Floor and Roof Drains	19
4-P1	Waste Rough-In for Lavatories	23
5-P1	Installation of Back Vents	27
6-P1	Installation of Urinal Waste and Venting	33
7-P1	Rough-In Piping for Showers	39
8-P1	Installing Waste Rough-In for Water Closets	43
9-P1	Testing Building Waste Systems	45

1B -75-748

This supersedes WB 3ABR55235-II-1-P1 thru 9-P1, 27 June 1974. (Copies of the superseded publication may be used until the supply is exhausted.)

Department of Civil Engineering Training
Sheppard AFB, Texas

WB 3ABR55235-II-1-P1
1 November 1974

BUILDING DRAINS

OBJECTIVES

When you have completed this workbook you will be able to:

1. Identify the material used for a building drain.
2. Draw a building drain using symbols.
3. Make a complete bill of materials for a building drain.
4. Measure and mark cast-iron pipe.

EQUIPMENT	BASIS OF ISSUE
SG 3ABR55235-II-1	1/student
WB 3ABR55235-II-1-P1	1/student
Cast-iron Pipe	1/student
Booth area	1/student
Toolboxes	1/student

PROCEDURE

Mission 1

Referring to the training display pointed out by the instructor, identify the material used for the building drain.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________

201

Mission 2

Using the drawing that applies for your booth area and the proper symbols, draw the building drain.

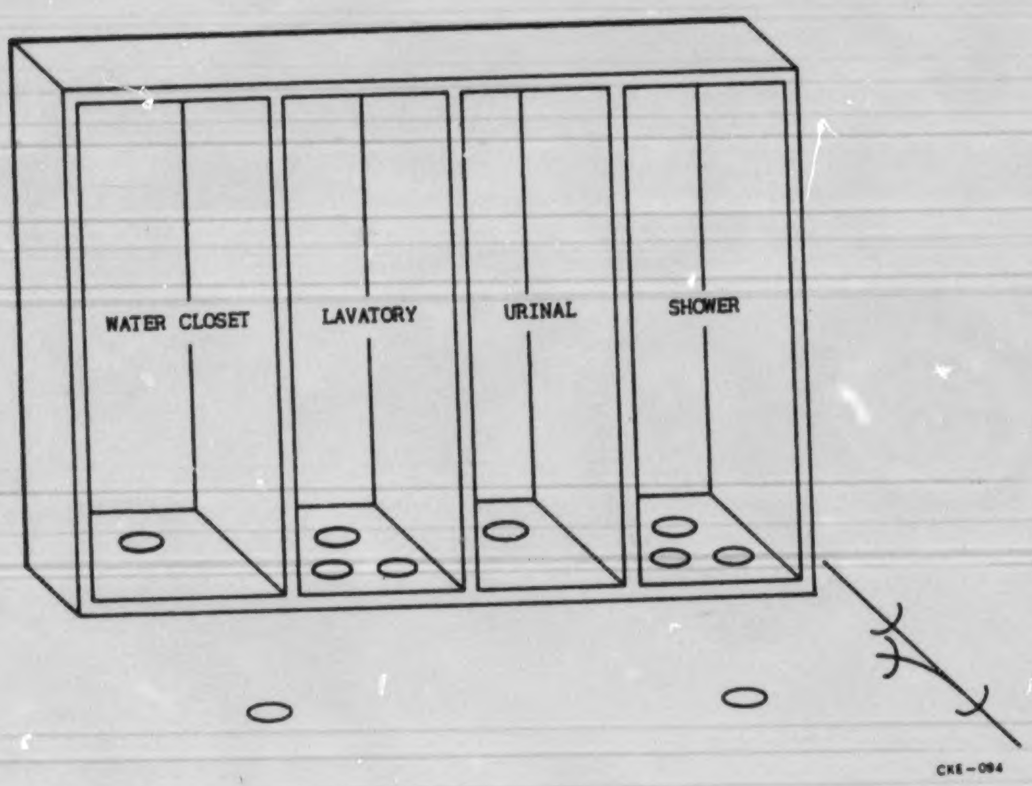

WATER CLOSET
LAVATORY
URINAL
SHOWER
CKE-094

Figure 1. Booth Area Room 37

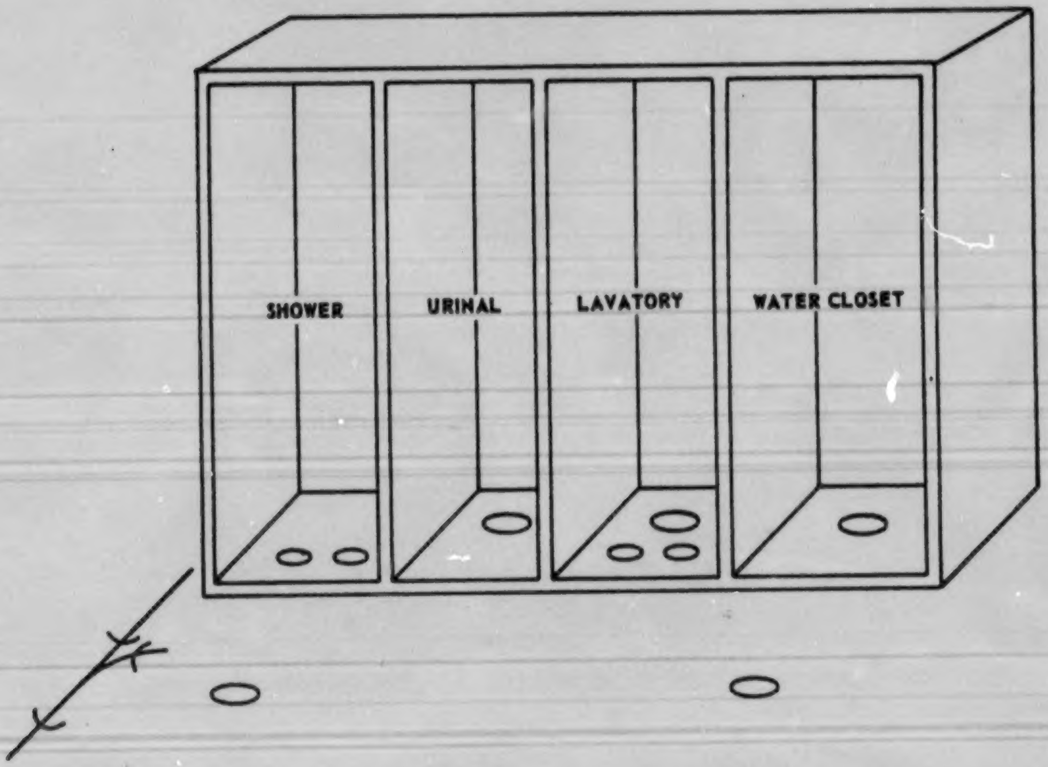

SHOWER
URINAL
LAVATORY
WATER CLOSET

Figure 2. Booth Area Rooms 35 and 37

Mission 3

From the system drawn in Mission 2, make a complete bill of material.

Mission 4

1. Cast-iron pipe is measured from the ____________ of the ________ to the ____________ end.
2. Fittings are measured from the back of the ____________ to the ____________, or from the centerline to the ____________ end.
3. Using a measuring tape or rule, measure and mark a pipe IAW instructions given by the instructor.

204

CUTTING AND FABRICATING FOUR-INCH CAST-IRON PIPE
D

OBJECTIVES

When you have completed this workbook you will be able to:

1. Cut cast-iron pipe using a hammer and chisel.
2. Cut cast-iron pipe using a snap cutter.
3. Cut cast-iron pipe using a hacksaw and an adjustable wrench.
4. Handle compressed gas containers safely.
5. Assemble and operate plumber's furnace.
6. Assemble and pour a horizontal joint.
7. Construct a building drain.

EQUIPMENT	BASIS OF ISSUE
SG 3ABR55235-II-1	1/student
W B 3ABR55235-II-1-P2	1/student
Plumber's Tool Kit	1/2 students
Plumber's Furnace	1/2 students
Safety Equipment	1/student
Training Display	1/class
Compressed Gas Cylinder	1/6 students

PROCEDURES

Mission 1

1. The oldest method of cutting cast-iron pipe is a ______________________________ and a ______________________________.

2. When working outside, a mound of ______________________________ is used to support the pipe.

3. Using a hammer and chisel and the piece of cast-iron pipe from project 4, cut the pipe on the mark.

Mission 2

1. What safety measure must be taken when cutting cast-iron pipe using a snap cutter?
2. Which direction must the adjustment screw be turned when fastening the chain on a snap cutter?
3. Cut cast-iron pipe using a snap cutter.

Mission 3

1. When would a hacksaw and adjustable jaw wrench be used to cut cast iron?
2. How is the pipe secured using the above method to cut cast-iron pipe?
3. How deep should the pipe be scored with a hacksaw?
4. Cut cast-iron pipe using a hacksaw and adjustable jaw wrench.

Mission 4

1. Which gas cannot be transported in a horizontal position?
2. What are some of the hazards pertaining to gas cylinders?

3. What are some of the safety hazards that are used when storing gases?

Mission 5

1. What safety precautions must be practiced when lighting a plumber's furnace?

2. What is the name of the item used to hold lead when it is being melted?

3. Assemble and operate the plumber's furnace.

Mission 6

1. What tool is used to stuff oakum in a bell-and-spigot joint?

2. What tool is used to pack the oakum tight in the joint?

3. How much lead should be in the joint?

4. What tool is necessary to pour a horizontal joint?

5. Assemble and pour a horizontal joint.

Mission 7

1. How many 4 X 2 combo's will be in your booth area?____________________
2. How many 4" combo's will be used in your booth area?__________________
3. How many joints will have to be made in your building drain?

   ____
4. Assemble your building drain using the working drawing for your booth area.

COMPONENTS OF BUILDING DRAINS AND VENT SYSTEMS

OBJECTIVE

This project will aid you in learning to identify the major components of drain, vent, and stack systems.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
WB 3ABR55235-II-2-P1	1/student
Pencil	1/student

Mission 1

Identify the numbered portions of the drainage system illustrated below.

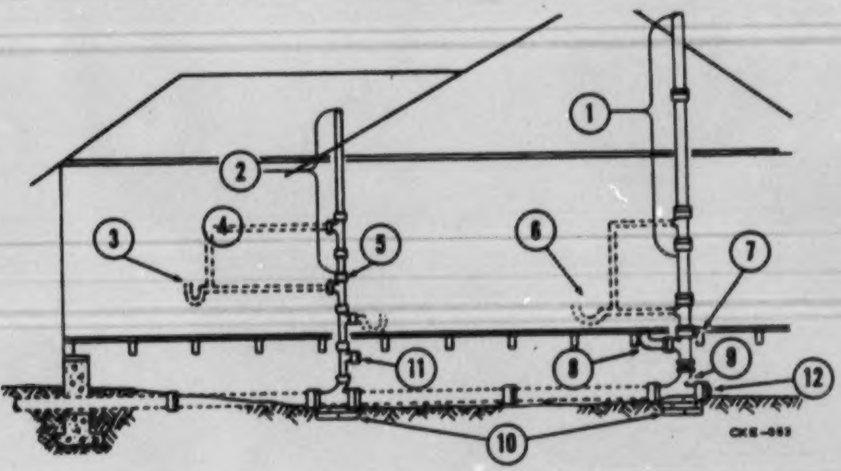


Figure 3. Drainage System

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________

Mission 2

Identify the components of the vent and drainage system in figure 4 by placing the correct letter by its name in the blanks below.

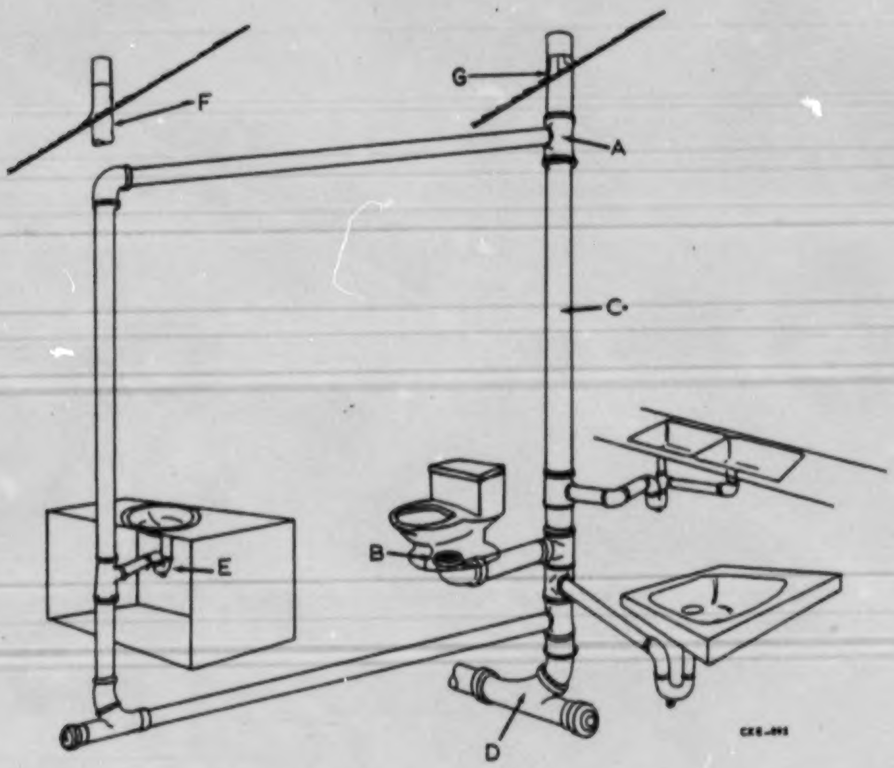


Figure 4. Vent and Drainage System

1. Secondary (optional) stack ____________________.
2. Combination wye and 1/8th bend ____________________.
3. Closet flange ____________________.
4. Soil stack ____________________.
5. P-trap ____________________.
6. Tapped vent tee ____________________.
7. Roof flashing ____________________.

FABRICATING VENTS AND STACKS

OBJECTIVE

This project will give you practical experience fabricating vents and stacks.

STANDARD OF PERFORMANCE

All completed work must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-2	1/student
WB 3ABR55235-II-2-P2	1/student
Toolkit	1/2 students
Shop tools	1/2 students
Pipe and Fittings	

Mission 1

TYPICAL PLUMBING VENT SYSTEM

1. Using figure 5, make a sketch of a typical plumbing vent system.
2. Name the major component parts of a typical plumbing vent system.

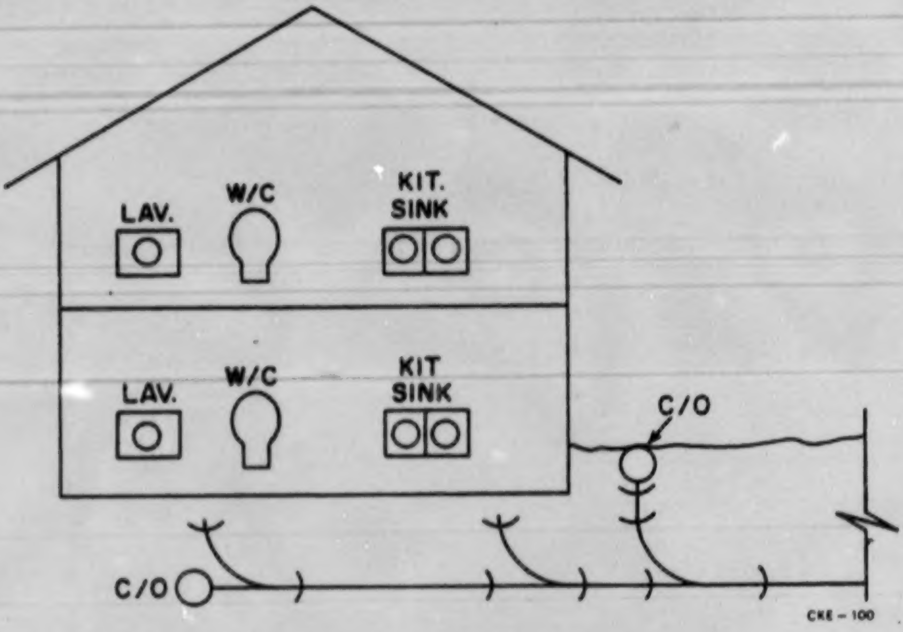


Figure 5. Plumbing Vent System

Mission 2

1. The two different methods of calking a joint are __________ __________ and __________ __________.

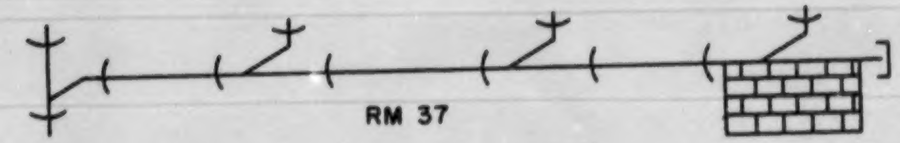
2. The __________ calked method must be used if the joint to be calked is under water or heating devices cannot be used.

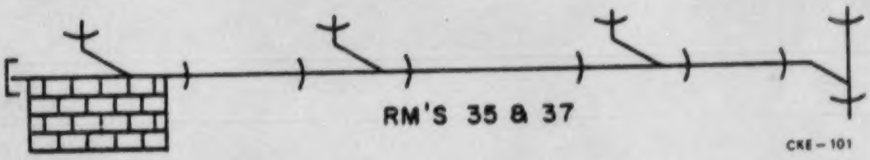
3. Which method of joining cast-iron soil pipe depends on the displacement of the rubber gasket for a leakproof joint? __________.

4. No-hub joints use a one-piece __________ __________ and a __________ __________ shield and retaining clamps. These clamps are fastened by using an __________ pound __________ wrench. The desired degree of tightness is not less than __________ nor more than __________ inch-pounds. Space inside of the gasket where the fittings or pipe ends meet measure ______ inch; therefore, when fabricating a system with no-hub, you must __________ this measurement for each connection.

Mission 3

1. Select the drawing below for the building drain in the classroom and prepare a working drawing of the soil stack and stack vent.





CKE – 101

2. Make a list of materials for a main vent stack in the booth area.

    a.

    b.

    c.

    d.

    e.

    f.

    g.

    h.

    i.

    j.

3. Select the required pipe and fittings to construct a main vent stack in the booth area.

GRADING PIPE

OBJECTIVE

This workbook is designed to give you practical experience using a spirit level to grade a vent and stack system.

STANDARD OF PERFORMANCE

All completed work must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
Toolkit	1/2 students
Special Tools	1/2 students
Shop Tools	1/2 students
Pipe and Fittings	

Mission 1

GRADE A VENT AND STACK

1. Place a level on one side of the installed vent stack.
2. Position the pipe so that the bubble is in the center of the marking on the level.
3. Block the pipe in position.
4. Place the level in a position approximately 1/4 around the pipe.
5. Repeat step 2.
6. Repeat step 3.
7. Check the first alignment and realign if necessary.
8. Check the second alignment and realign if necessary.
9. Repeat steps 7 and 8 until the pipe is aligned vertically.

ATTACHING PIPE TO BUILDING STRUCTURE

OBJECTIVE

The workbook will aid you in learning where and how to attach pipe to a building structure.

STANDARD OF PERFORMANCE

All work must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-2	1/student
WB 3ABR55235-II-2-P4	1/student
Toolkit	1/2 students
Pipe and Fittings	
Nails	

Mission 1

PROCEDURES

1. Using the list of building materials below, fill in the blanks with the type of material that can be used to hang pipe.

   a. Cast iron ______________________________

   b. Steel ______________________________

   c. Plastic ______________________________

   d. Copper ______________________________

2. How often should the following types of pipe be supported.

   a. Horizontal

      (1) Cast iron ______________________________

      (2) Lead ______________________________

   b. Vertical

      (1) Cast iron ______________________________

      (2) Lead ______________________________

3. What material should be used to construct a stack base? ____________________

Misstion 2

1. Select two joints of 4" cast-iron pipe.

2. Connect the two sections.

Note: This is a temporary connection and doesn't have to be watertight.

3. Use hanger material and hang the pipe to a building structure.

4. What direction should the water be flowing in this pipe? ____________________

5. How much drop should there be in these two sections of pipe? ____________________

2F -75-748

FLOOR AND ROOF DRAINS

OBJECTIVE

This workbook will give you practical experience making a bill of materials and identifying the components of a roof and floor drain.

STANDARD OF PERFORMANCE

All work must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-3	1/student
WB 3ABR55235-II-3-P1	1/student

Mission 1

FLOOR DRAIN

Make a bill of materials for the installation of the roof drain illustrated in figure 6.

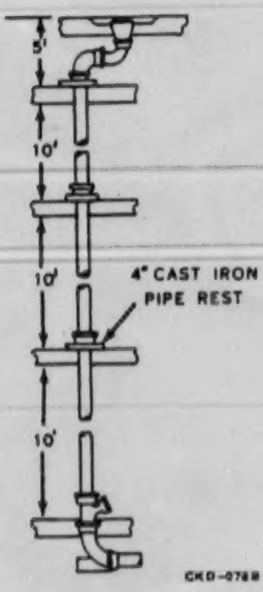

5'
10'
10'
10'
4" CAST IRON
PIPE REST
CKD-0788

Figure 6. Floor Drain

Mission 2

Using figure 7, make a bill of materials necessary for the installation of a floor drain.

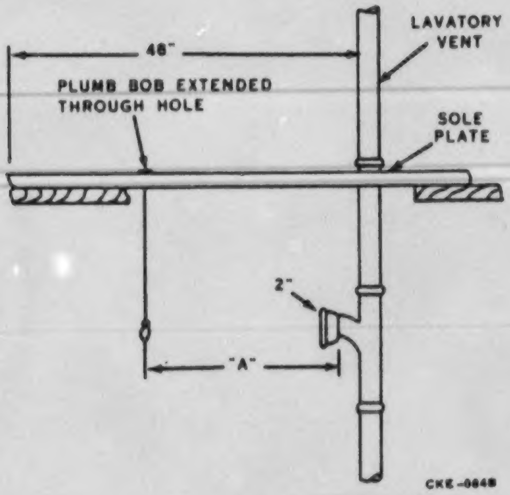

48"
PLUMB BOB EXTENDED THROUGH HOLE
LAVATORY VENT
SOLE PLATE
2"
"A"
CKE-0648

Figure 7. Floor Drain

WASTE ROUGH-IN FOR LAVATORIES

OBJECTIVE

This project will give you practical experience

1. making a list of materials for the rough-in of a lavatory.
2. identifying the major components of the rough-in materials for a lavatory.
3. install the vent pipe for a lavatory.

STANDARD OF PERFORMANCE

All work must comply with the standards in AFM 85-20.

EQUIPMENT	BASIS OF ISSUE
SG 3ABR55235-II-4	1/ student
WB 3ABR55235-II-4-P1	1/student
Rough-in Specifications	1/2 students

Mission 1

Using the rough-in specification, in figure 8, answer the following questions.

1. What is the size of the lavatory? ______________________________

2. How many inches out from the wall is it to the center of the faucets?

   ____

3. How many inches is it from the finished floor to the center of the drain using a pop-up waste? ______________________________

4. How many inches is it from the lip of the fixture to the finished floor?

ROUGHING-IN DIMENSIONS

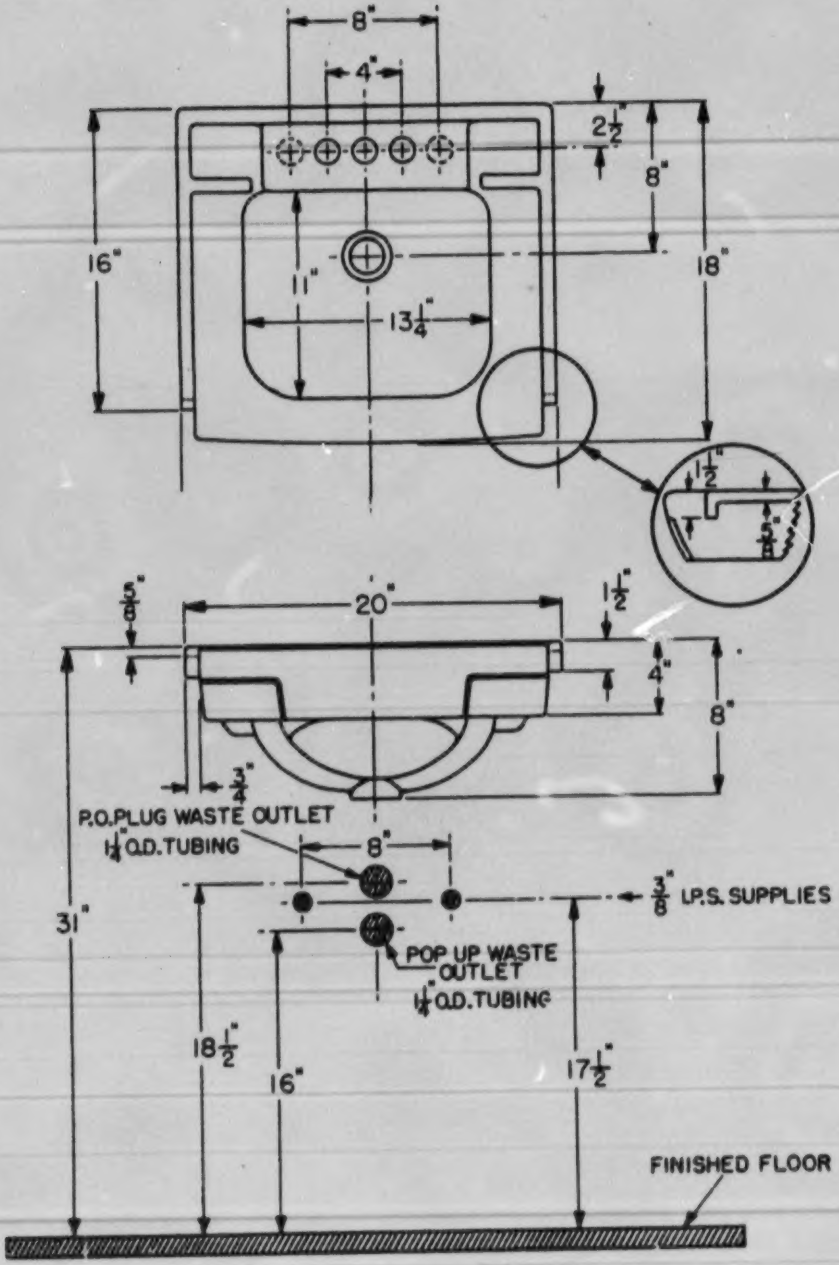

8"
4"
2½"
8"
16"
18"
11"
13¼"
1½"
5/8"
5/8"
20"
1½"
4"
8"
3/4"
P.O.PLUG WASTE OUTLET
1¼" O.D.TUBING
8"
3/8" I.P.S. SUPPLIES
31"
POP UP WASTE OUTLET
1¼" O.D.TUBING
18½"
16"
17½"
FINISHED FLOOR

Figure 8 CKA-067

5. **Make a list of the materials required for the rough-in of the lavatory waste piping in your booth. Use figure 9.**

Note: **The rough-in of the vent piping will be accomplished in the next unit of instruction.**

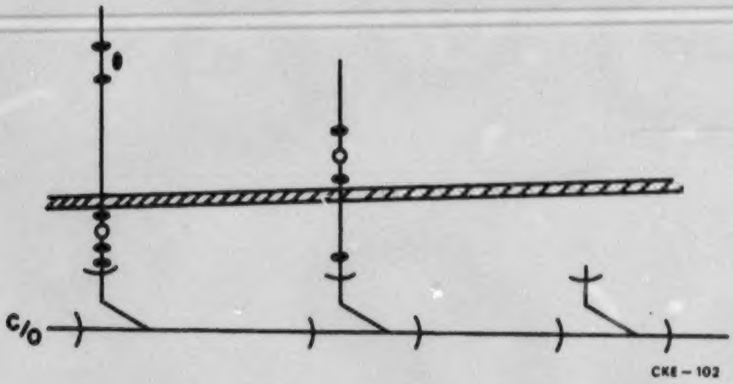


Figure 9. Lavatory Waste Piping

Note:

1. **Use calked joints in the horizontal building drain piping.**
2. **Use no-hub connections in the vertical, soil, waste, and vent piping.**

INSTALLATION OF BACK VENTS

OBJECTIVE

This project will give you practical experience identifying the construction features of vent systems, making a list of materials required to construct a vent system, and constructing a vent system.

STANDARD OF PERFORMANCE

All completed work must comply with the standards outlined in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-5	1/student
WB 3ABR55235-II-5-P1	1/student
Plumber's Toolkit	1/2 students
Shop and Special Tools	1/2 students
Plumber's Furnace	1/2 students
Safety Equipment	1/student

Mission 1

Use either figure 10 or 11 and sketch the drainage and vent system for the lavatory to be installed in your booth area.

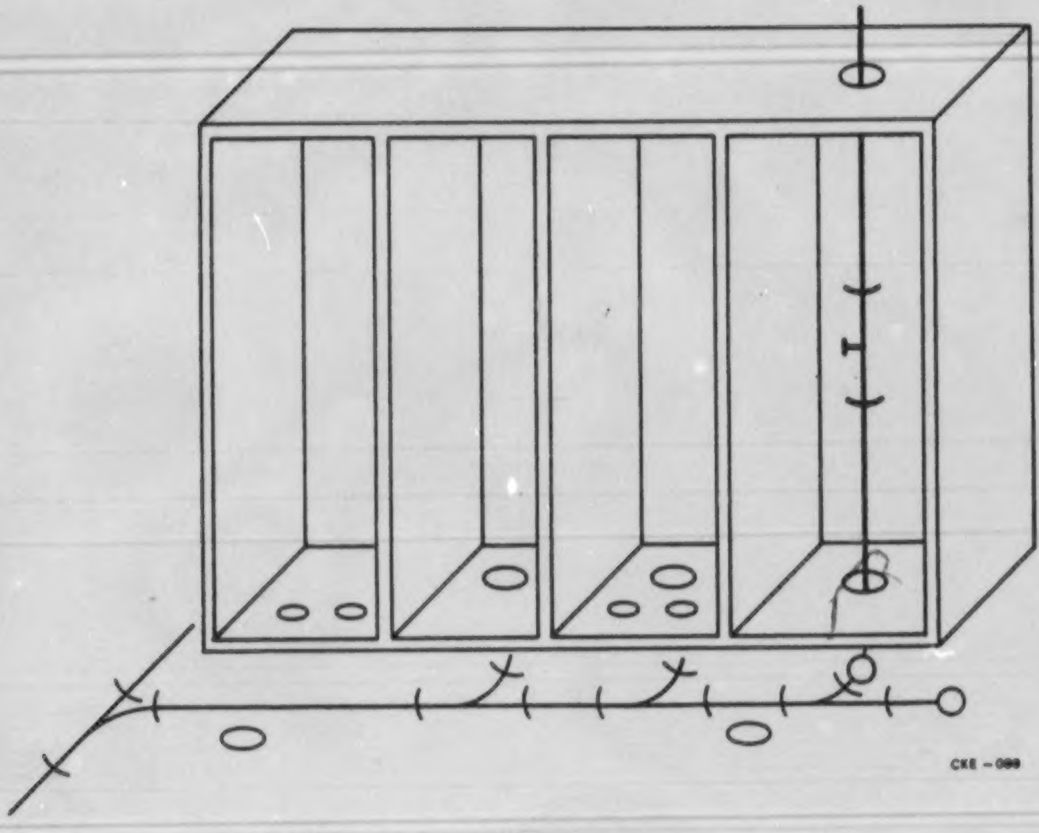


Figure 10. Room 37 Individual back vent

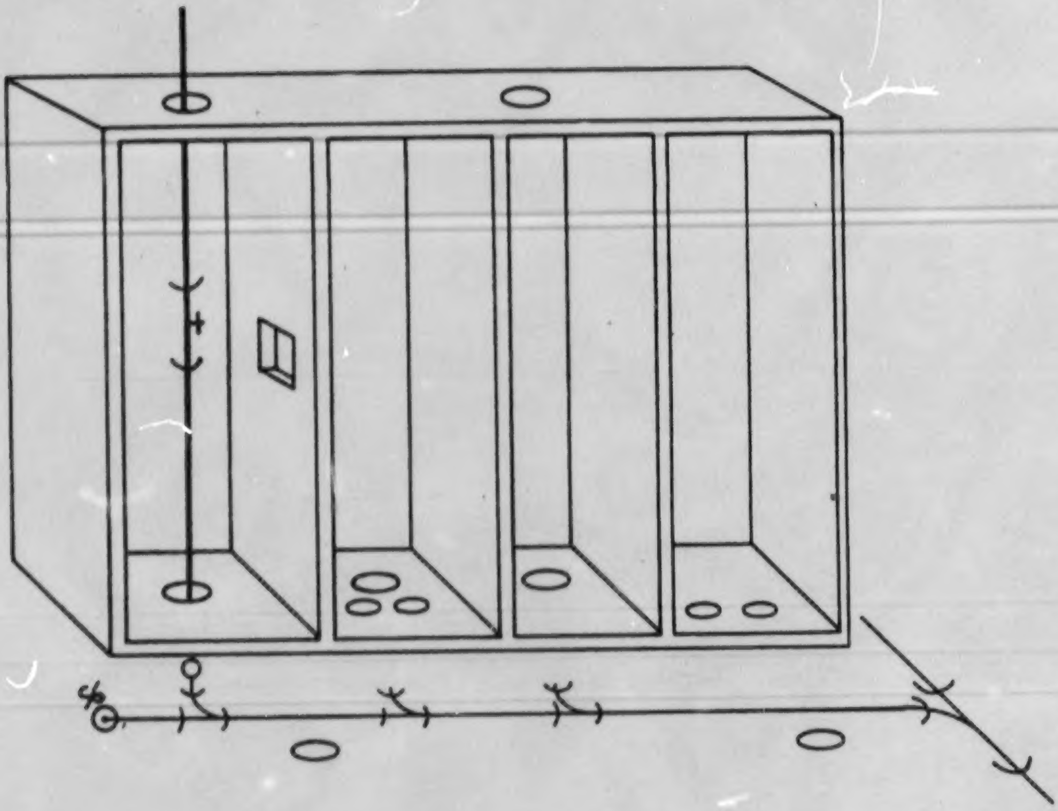


Figure 11. Rooms 35 and 37 Individual back vent

225

Mission 2

1. Make a bill of materials for the construction of the lavatory vent.

   a. ______________________

   b. ______________________

   c. ______________________

   d. ______________________

   e. ______________________

   f. ______________________

   g. ______________________

   h. ______________________

   i. ______________________

   j. ______________________

2. List the tools that will be used to construct the vent.

   a. ______________________

   b. ______________________

   c. ______________________

   d. ______________________

   e. ______________________

   f. ______________________

   g. ______________________

Mission 3

1. Use the material list from mission 2 and procure the required material from supply.

   Note: You won't be able to get a pipe in the lengths required so you will have to measure, cut, and thread the pipe to your specifications.

2. Measure the length of one section of pipe.

257

3. Cut the pipe using a snap cutter.

   Note: Have another group of students measure and cut pipe for another section of the vent. Make sure that each group of students gets to measure and cut a section of pipe.

4. Use the cut pipe and necessary fitting and assemble the vent system in the booth area.

INSTALLATION OF URINAL WASTE AND VENTING

OBJECTIVE

This project will give you practical experience identifying the types of urinal venting systems, making a bill of material for a urinal venting system, and constructing a urinal vent system.

STANDARD OF PERFORMANCE

All completed work must comply with the standard in AFM 85-20.

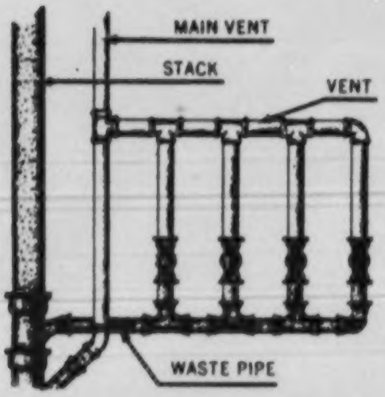
EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-VI-6	1/student
WB 3ABR55235-IV-6-P1	1/student
Plumber's Toolkit	1/2 students
Shop and Special Tools	1/2 students
Plumber's Furnace	1/2 students

Mission 1

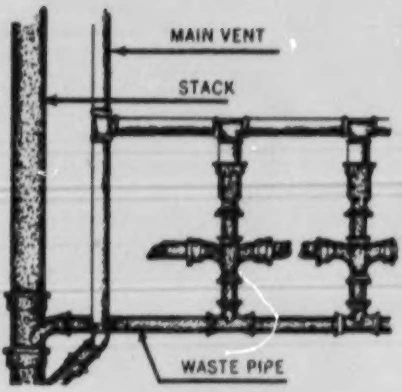
PROCEDURES

1. Examine the following three types of urinal vents.

2. Write the name of each type of vent in the blank spaces.

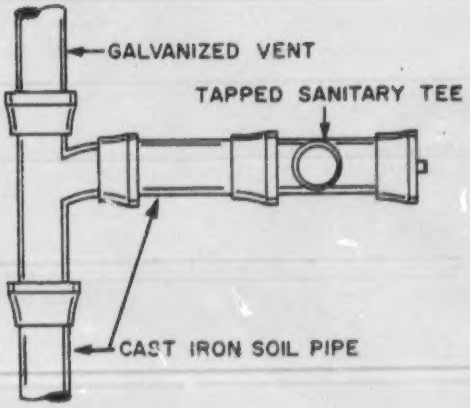


a. ______________________________



b. ______________________________

228


GALVANIZED VENT
TAPPED SANITARY TEE
CAST IRON SOIL PIPE

c. ______________________________

Mission 2

Make a working drawing and bill of materials for the urinal drain and vent system to be built in your booth area.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

3F -75-748

Mission 3

List the tools that you will need to install the urinal drain and vent.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

f. ______________________

g. ______________________

h. ______________________

i. ______________________

j. ______________________

Mission 4

Using the rough-in specifications below, answer the following questions.

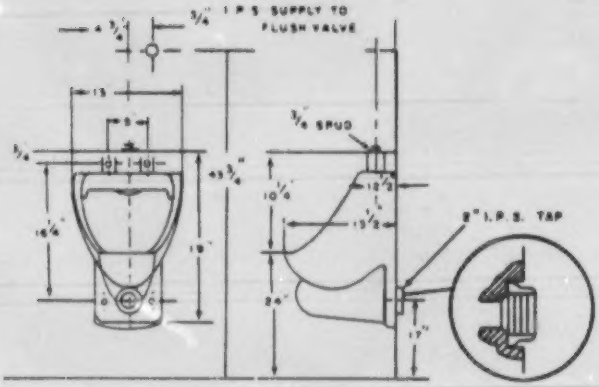
a. What is the height for the rough-in of the drain? ______________________

b. What is the height from the floor to the lip of the urinal? ______________________

c. What is the width of the urinal? ______________________

d. What is the distance between the upper and lower boltholes? ______________________

____

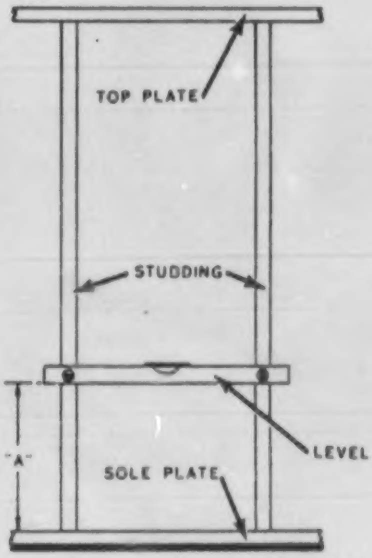

4 3/4"
3/4" I P S SUPPLY TO FLUSH VALVE
13
8
3/4
43 3/4"
16 1/4"
19"
3/4" SPUD
10 1/4"
12 1/2
13 1/2
2" I.P.S. TAP
24"
17"

CKA—077

Manufacturer's Rough-in Specification Sheet for Wall Hung Urinal

Mission 5

1. Procure the materials listed in mission 2.
2. Procure the tools listed in mission 3.
3. Obtain the floor height of the waste system outlet ("A" in figure 12) from the manufacturer's rough-in specifications or your instructor. Mark the studding as shown in figure 12.
4. Using a level and rule, determine the floor height of the urinal waste opening. (From bottom of hub, under the floor, to top of level, give center of drainage tee opening.)
5. Using measurement found in step 3, measure, mark, and cut cast-iron pipe.
6. Assemble tapped tee and soil pipe.
7. Determine the required height of the vent stack pipe.
8. Measure, mark, and cut the pipe for the vent stack.
9. Assemble the vent stack to the tapped tee and recheck all measurements.


TOP PLATE
STUDDING
"A"
LEVEL
SOLE PLATE

CKD—074A

Figure 12. Measuring and Marking Rough-in Urinal Waste Outlet

10. Position the assembly in place and align the tapped tee.
11. Tighten no-hub clamp.
12. Have the instructor check your work.
13. Clean all tools and return tools and materials to storage.

ROUGH-IN PIPING FOR SHOWERS

OBJECTIVE

This project will give you practical experience identifying the construction features of shower and tub drains and installing a tub drain.

STANDARD OF PERFORMANCE

All completed work must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-7	1/student
WB 3ABR55235-II-7-P1	1/student
Plumber's Toolkit	1/2 students
Shop and Special Tools	1/2 students

Mission 1

1. Open SG 3ABR55235-II-7 to the figure illustrating a typical shower drain.

2. Identify and explain the purpose of each component part of the shower drain.

	Part	Purpose
a.		
b.		
c.		
d.		
e.		
f.		
g.		
h.		

Mission 2

1. Extend a plumb bob through the floor drain opening as shown in figure 13.

2. Determine the horizontal distance between the waste stack opening and the floor drain opening. ______________________________

3. Determine the horizontal span of the trap as shown by "A" in figure 13. Record this measurement ______________________________

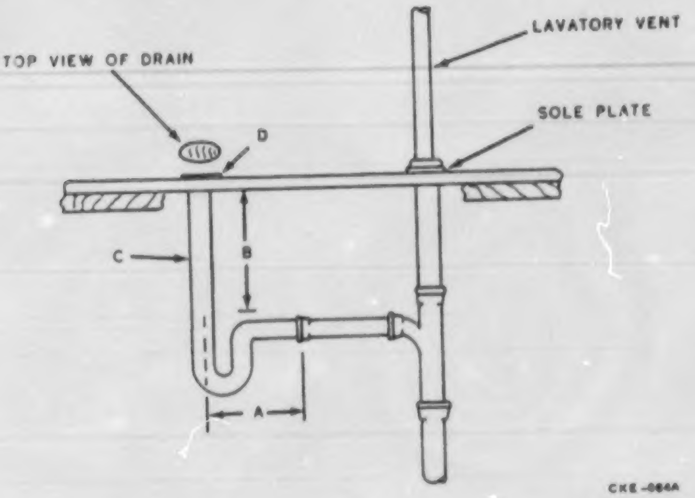


Figure 13

4. Subtract measurement found in step 2 from measurement found in step 3 and record their difference. ______________________. Subtract for the shoulder of the no-hub gaskets.

5. Using measurement found in step 4, measure, mark and cut a 2" cast-iron soil pipe.

6. Join the P-trap and 2" cast-iron soil pipe that was cut in step 5.

7. Place assembly in position and block or support it at the proper grade.

8. Determine the length of pipe needed to connect the trap to the floor drain as shown by "B" in figure 13.

9. Using measurement found in step 8, measure, mark, and cut this drain pipe.

10. Install the 2" waste pipe between the trap and floor drain opening as shown by "C" in figure 13.

11. Install the floor drain assembly.

Note: The floor drain will connect to the waste pipe by an inside calked joint.

INSTALLING WASTE ROUGH-IN FOR WATER CLOSETS

OBJECTIVE

This project will give you practical experience locating and identifying the components of a vent and drain system for a water closet installation, making a bill of materials for, and constructing a vent and drain system for a water closet.

STANDARD OF PERFORMANCE

The completed vent and drain system for the water closet must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-8	1/student
WB 3ABR55235-II-8-P1	1/student
Plumber's Toolkit	1/2 students
Shop and Special Tools	1/2 students

Mission 1

1. Name each lettered component in the vent and drain system illustrated in figure 14.

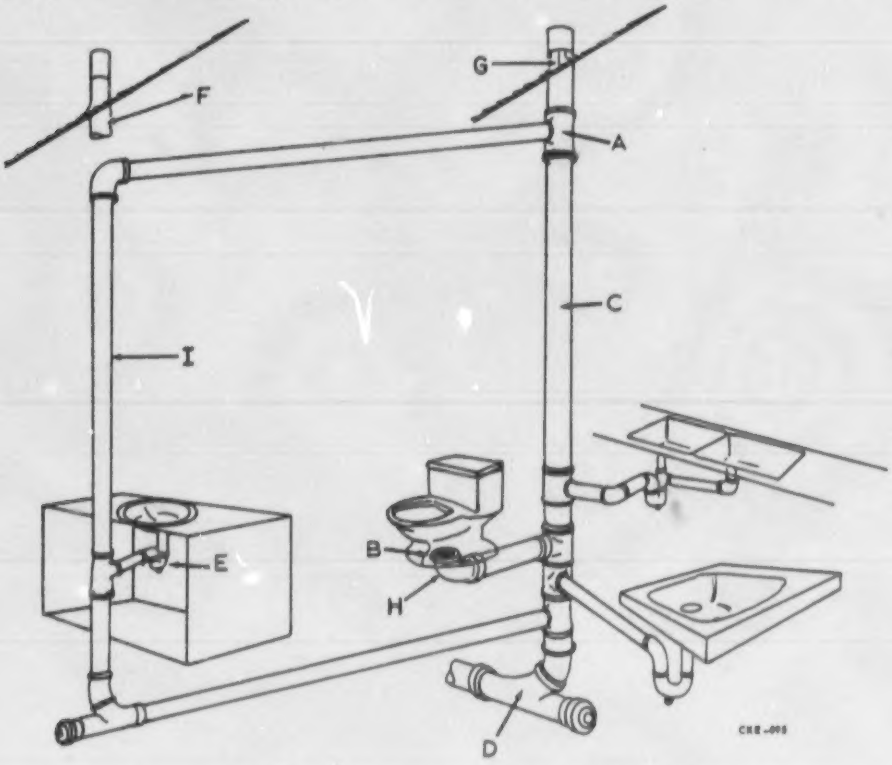


Figure 14. Vent and Drain System for a Water Closet

Mission 2

Make a working drawing and bill of materials for the installation of drainage system for the water closet installation in your booth area.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________

Mission 3

1. Procure the materials listed in mission 2.
2. Construct the drainage system for the water closet in your booth area.

TESTING BUILDING WASTE SYSTEMS

OBJECTIVE

This project will give you practical experience testing and repairing leaks in a newly constructed waste system.

STANDARD OF PERFORMANCE

All completed work must comply with the standards in AFM 85-20.

EQUIPMENT AND SUPPLIES	BASIS OF ISSUE
SG 3ABR55235-II-9	1/student
WB 3ABR55235-II-9-P1	1/student
Plumber's Toolkit	1/2 students
Shop and Special Tools	1/2 students
Rough-in Specifications	1/2 students
Shop Drawings	1/2 students

Mission 1

Name the equipment needed to perform a water test on a waste system.

1. ______________________

2. ______________________

3. ______________________

4. ______________________

5. ______________________

6. ______________________

7. ______________________

8. ______________________

Mission 2

1. List the steps (in correct sequence) that must be performed when testing a waste system with water.

   a. ______________________

   b. ______________________

   c. ______________________

   d. ______________________

   e. ______________________

   f. ______________________

   g. ______________________

2. Name the tool that is used to remove lead from a hub.

   ____

3. Draw a sketch of an insertable joint (Sisson).

4. Explain one method of repairing a leaking calked joint.

   ____

   ____

   ____

   ____

   ____

5. Name the tools needed to repair any leaks that you may find while testing the system with water.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

   g. ______________________________

   h. ______________________________

6. Name other types of testing methods used on a drainage system.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

Mission 3

TESTING A DRAINAGE SYSTEM WITH WATER

1. Plug all openings except ______________________________.

2. Fill system to a point of overflow.

3. The system will be tested with no less than ____________________ foot head of water.

4. Allow water to stand in system for ____________ to ____________.

5. After the soaking period is over, water must remain at a constant level for

   ____________________ minutes.

6. What tools will you need to reseal a poured joint?

7. Name the tool used to remove lead from a hub.

8. Draw a sketch of an insertable joint (Sisson).

9. State the method of repairing a leaking calked joint.

ATC-SHEPPARD AFB TEX. 78-740

3-22 241

LESSON PLAN (Part I, General)

AUTHOR, OFFICE AND DATE TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply Systems

LESSON TITLE
Exterior Water Supply (Day 20)

LESSON DURATION

CLASSROOM/LABORATORY 3 Hrs	COMPLEMENTARY 0	TOTAL 3 Hrs

POI REFERENCE

PAGE NUMBER 30	PAGE DATE 2 July 1975	PARAGRAPH 1

STS/CTS REFERENCE

NUMBER 552X5	DATE 15 February 1973, Chg. 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Shop Tools Sample Board of Plumbing Hardware	4" Cast Iron	None	SG III-1 WB III-1-P1 Map: Water Dist. System Slides: Exterior Water System

CRITERION OBJECTIVES AND TEACHING STEPS

1a. Given a drawing or map of an exterior water supply system, locate and name the major components. All six components must be named correctly.

(1) Water distribution system
(2) Valves listings and appurtenances

1b. Using given information, list the steps necessary to assemble cement asbestos pipe using a rolling ring and flanged pipe and fittings. All the steps must be in correct sequence.

(1) Assembly of cement asbestos pipe using rolling ring
(2) Flanged joints

1c. Working as a member of a team, cut cast iron pipe to a given length ± 1/8 inch with a chain cutter.

(1) Material used and methods of cutting
(2) Types of joints
(3) Use of chain cutters

ATC FORM AUG 73 770

☆ GPO: 1973 779-366/38

Course No: 3ABR55235
Day: 20

Branch Approval:
Date: 22 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (2 Hrs 10 Minutes)

PRESENTATION:

1a. Given a drawing or map of an exterior water supply system, Locate and name the major components. All six components must be named correctly.

(1) Water distribution system

(a) Laid out in loops with no dead ends

(b) Water can flow in more than one direction

(c) Allow for future expansion of the system

(d) Major components of system

1 Source

2 Pumps

3 Treatment plant

4 Water storage

5 Distribution piping

6 Fire hydrants

7 Control valves

(e) Maps and records

1 Valve location

2 Hydrant location

3 Maintenance record

(f) Source

1 Wells

2 Rivers

3 Reservoirs

4 Lakes

(g) Pump stations

245

1 Pumps water from source to plant

2 Pumps to storage tank

3 Types of pumps

  a Centrifigul

  b Diaphram

(h) Treatment plant

  1 Chlorination-kills bacteria

  2 Floridation-Teeth protection

  3 Demineralization-remove minerals

  4 Filtering-remove suspended solids

(i) Water storage

  1 Types of tanks 277

    a Elevated

b Ground tank

2 Constructed of

a Steel

b Concrete

3 Purpose

a Pressurize system

b Back up supply

4 Located between plant and distribution system

(j) Distribution piping

1 Tree

2 Loop

3 Feeder mains

a Supply distribution mains

b Supply storage tanks

4 Service lines-from main to building

5 Fire hydrants

a Provides fire protection

b Isolation valve

c Flow test

d Pressure test

(2) Valves listings and appurtenances

(a) Identification of valves

1 Shape of valve

2 Markings on body

(b) Gate valve

- 1 Positive shut off
- 2 Large valves
  - a Cast Iron body
  - b Bronze or monel seats
- 3 Small valves
  - a Bronze body
  - b Bronze seat

(c) Globe valves

- 1 Throttle flow
- 2 Large valves
  - a C.I. body
  - b Bronze seat
- 3 Small valves

a Bronze body

b Bronze seat

(d) Check valves

1 Assures flow in one direction only

2 Large valves

a C.I. Body

b Bronze or monel seat

3 Small valves

a Bronze body

b Bronze seat

(e) Altitude valves

1 Keeps constant level in storage tanks

2 Mechanical type

a Operates by float

b Easiest to maintain

3 Electrical type

a Electrodes in tank

b Water level completes circuit to operate pumps and valves

(f) Pressure reducing valve

1 C.I. Body usually

2 Diaphram

3 Spring

4 Tension adjustment (explain)

(g) Sizing of mains

1 Usually done by engineer

251

2 Factors to consider

a Family housing

b Dormitories

c Civilian employees

d Size of hospital

(h) Types of systems

1 Potable

2 Non Potable

1b. Using given information, list the steps necessary to assemble cement asbestos pipe using a rolling ring and flanged pipe and fittings. All the steps must be in correct sequence.

(1) Assembly of cement asbestos pipe using rolling ring

(a) Pipe and coupling must be from same MFG.

(b) Cut pipe to length (methods used)

1 Handsaw

2 Snap cutters

3 Roller chain

4 Hammer & chisel

5 Concrete saw

(c) Prepare end of pipe (tapering tool)

(d) Lubrication

1 Coupling

2 Pipe

3 Rolling ring

(e) Align pipe and coupling

(f) Position pipe jack

(g) Jack pipe until firmly seated

(2) Flanged joints

(a) Types of flanged connections (must be matched)

1 Screwed

2 Welded

3 Slip one (uses rubber ring)

(b) Cut pipe to desired length (methods used)

1 Steel

a Hacksaw

b Pipe cutter

2 Cast iron

a Hacksaw

b Roller chain cutter

c Hydraulic snap cutter

(c) Assembly procedures

1 Screwed

a Thread pipe

b Pope pipe threads

c Screw flange on pipe

d Align bolt holes in flanges

e Insert tow bottom bolts

f Insert gasket between flanges

g Insert remaining bolts and tighten evenly

2 Welded (Procedures same as screwed except flange is welded to pipe ends)

3 Slip on type

255

a Slip flanges onto pipe ends (one must have hub)

b Slip rubber ring onto spigot end of pipe

c Align pipe ends and bolt holes

d Insert bolts and tighten evenly

1c. Working as a member of a team, cut cast iron pipe to a given length ± 1/8 inch with a chain cutter.

(1) Material used and methods of cutting

(a) Cast iron-jacketed and lined

1 Chain cutter

2 Hacksaw (power or hand)

3 Cutting torch

(b) Cement asbestos

297

1 Hammer and chisel

2 Chain cutter

3 Hand saw

(c) Plastic

1 Pipe cutter

2 Hand saw

(d) Galvanized and steel

1 Pipe cutter

2 Hack saw

3 Cutting torch

(e) Concrete

1 Concrete saw

2 Hammer and chisel

(2) Types of joints

(a) Calked

(b) Glued

(c) Welded

(d) Threaded

(e) Sleeved couplings

(3) Use of chain cutters

(a) Inspect cutters

(b) Place on mark

(c) Adjust spring tension

(d) Use chain tongs to hold pip secure

(e) Rotate back & forth

APPLICATION:

Have students complete Workbook 3ABR55235-III-1-P1

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Min)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT:

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply System

LESSON TITLE
Steel Pipe Assembly (Day 20)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
3 Hrs	0	3 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
31	2 July 1975	2

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Shop Tools Power Threader	Galvanized Steel Pipe Galvanized Fittings	None	SG III-2 WB III-2-P1 Film: FLC 3/150 Choosing the Right Valve

CRITERION OBJECTIVES AND TEACHING STEPS

2a. Using a power threader, cut, ream, and thread steel pipe. Finished work must be within ± 1/8-inch of given measurements.

(1) Holding devices
(2) Cutting
(3) Reaming
(4) Threading

2b. Using given instructions, assemble a piece of threaded steel pipe and a 90 degree elbow. The finished connection must be within ± 1/8 inch, of specifications measured from end to center.

(1) Use of pipe wrenches
(2) Procedures for pipe assembly

ATC FORM AUG 72 770

Course No: 3ABR55235
Day: 20

Branch Approved:
Date: 22 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (2 Hrs. 10 Minutes)

PRESENTATION:

2a. Using a power threader, cut, ream and thread steel pipe. Finished work must be within ± 1/8 inch of given measurements.

NOTE: Show film: "Choosing the right valve."

(1) Holding devices

(a) Bench vise

(b) Chain vise

(c) Strap vise

(d) Lead jaws

(e) Power sleeves

(f) Portable vises

(2) Cutting

(a) Hand operated

(b) Hacksaw

1 32 T.P.I. -Thin Metal

2 18-24 T.P.I. Thick Metal

(c) Power cutter

(3) Reaming

(a) Restores inside diameter of pipe

(b) Tools used

1 File

a Round-(rat tail)

b Half round

c Quarter round

2 Pipe reamer

a Desired tool

b Don't over ream

(4) Threading

(a) Types

1 Receding die Head

2 Power threaders

3 Fixed die

4 Gear threader

5 Power driven vise stand

(b) Procedures for using power threader

1 Pre-operational check

a Check power cord and ground

b Check oil in sump

c Select die head required

d Set die head

2 Operation

a Insert pipe in machine

b Close rear chuck

c Close front chuck

d Die head should be closed

e Turn switch to forward "ON"

f Oil should be flowing to die segments (important)

g Use firm pressure to start threading

h When thread is cut open die

i Back off carriage

j Raise die head

k Stop motor

l Loosen chucks and remove pipe

3 Post operational check

a After all threads are cut clean die head

b Remove chip tray and clean

c When oil in sump becomes contaminated, change it

d Always check oil level

2b. Using given instructions, assemble a piece of threaded steel pipe and a 90 degree elbow. The finished connection must be within ± 1/8 inch, of specifications measured from end to center.

(1) Use of pipe wrenches

  (a) Select proper size wrench

  (b) Apply wrench to pipe

  (c) Adjust wrench to fit pipe

  (d) Pipe should be all the way in the jaws

  (e) Use back up wrench when required

(2) Procedure for pipe assembly

  (a) Check threads on pipe and fitting

  (b) Apply pipe dope to pipe end

  (c) Start pipe on fitting by rotating clockwise

  (d) Tighten with pipe wrenches (do not over tighten)

APPLICATION:
Have students accomplish workbook 3ABR55235-III-2-P1

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lessen for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT:

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply System

LESSON TITLE
Installation of Building Service Lines (Day 21)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
6 Hrs	2 Hrs	8 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
32	2 July 1975	3

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg. 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Main Tapping Machine Hand Tools Water Main Trainer Shop Tools	None	None	SG III-3 WB III-3-P1 Film: CE-10 Slides: Building Service Lines

CRITERION OBJECTIVES AND TEACHING STEPS

3a. Given a sketch of a typical building service line, locate, name and give the purpose of each major component. All six components must be identified correctly.

(1) Nomenclature, purpose and location of components
(2) Factors governing pipe sizing

3b. Make a drawing of a building service line and label each component. Retain this information as it will be used later.

(1) Types of joints
(2) Symbols of valves, fittings

ATC FORM AUG 72 770

LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

3c. Using a drawing of a building service line, make a list of the materials needed to construct a service line. The bill of materials must accurately identify all the materials without shortage and without excess greater than 10%.

(1) Bill of materials
(2) Take off items

3d. Using the self-tapping machine and the procedures outlined in training film CE-10, tap a pressurized water main and install a corporation stop. Completed work must withstand line pressure without leaking.

(1) Identification and operation of tapping machine
(2) Tapping pressurized and non-pressurized water mains
(3) Safety hazards

Course No: 3ABR55235
Day: 21

Branch Approval: Robert B Harper Jr
Date: 22 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5hrs & 10 min)

PRESENTATION:

3a. Given a sketch of a typical building service line, locate, name, and give the purpose of each major component. All six components must be identified correctly.

(1) Nomenclature purpose and location of components

(a) Cooperation stop (Cock)

1 Used as a tap into the water main

2 Generally installed with a tapping machine

3 Can be used with a saddle

(b) Goose neck

1 Used to prevent breakage and damage to cooperation stop (cock)

(c) Swing joint

1 Used to protect the cooperation lock

- 2 Consist of two elbows and nipple

(d) Expansion loop

- 1 Used to protect cooperation stop
- 2 Is a loop of soft drawn copper

(e) Pipe used as building service

- 1 Copper tubing (Type K)
  - a Less joints using soft drawn
  - b Withstands corrosion
- 2 Galvanized pipe.
  - a 21' lengths
  - b Joint screwed together
- 3 Plastic pipe (PUC) (ABS)
  - a 21' lengths

b Joints welded

(f) Curb stop

1 Used as an outside shut off

2 Located inside the property line
in a curb box

3 Made of bronze or brass

(g) Meter stop

1 Two stops are generally used

2 They are gate valve design

3 Made of copper or brass

(2) Factors governing pipe sizing

(a) Number of people occupying the dwelling

(b) Type of equipment in the building

3b. Make a drawing of a building service line and label each component. Retain this information as it will be used later.

(1) Types of joints

(a) Soldered

(b) Mechanical

(c) Screwed

(d) Welded joints

(2) Symbols for valves and fittings

(a) Gate valve

(b) Stop & waste

(c) Elbow

(d) Soldered joint

(e) Welded joint

275

(f) Screwed joint

(g) Flanged

3c. Using a drawing of a building service line, make a list of the materials needed to construct a service line. The bill of materials must accurately identify all the required materials without shortages and without excess greater than 10%.

(1) Bill of materials-all materials needed to install the service line.

(2) Take off items-items needed to install the service that is not on the Bill of Materials, example (pipe dope)

3d. Using the self-tapping machine and the procedures outlined in training film CE-10, tap a pressurized water main and install a corporation stop. Completed work must withstand line pressure without leaking.

(1) Identification and operation of tapping machine

(a) Identification and operation of tapping machine

1 Saddle gasket

307

2 Saddle

3 Chamber gasket

4 Tie down chain

5 Main body

6 Flop valve

7 By pass valve

8 Feed yoke

9 Boaring bar

10 Ratchet handle

11 Combination drill and top

12 Adapter

(b) Operation of taping machine

1 Maximum water pressure that tap can be made is 90 PSI

2 Largest tap made under pressure is 1" inch

(2) Tapping pressurized and nonpressurized water mains

(a) Pressurized method is used on existing mains

(b) Non-pressurized methods used on new main (bring installed).

(3) Safety hazards

(a) Never tap main over 90 PSI

(b) Use caution when removing boring bar

(c) Observe all safety precautions

APPLICATION:

Complete WB 3ABR55235-III-3-P1

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT:

Read SG 3ABR55235-III-4 and answer questions at the end of chapter.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply System

LESSON TITLE
Building Distribution System (Days 22 and 23)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
12 Hrs	4 Hrs	16 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
34	2 July 1975	4

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	Galvanized Pipe Galvanized Fittings	None	SG III-4 WB III-4-P1 Blueprints and Drawings

CRITERION OBJECTIVES AND TEACHING STEPS

4a. Using blueprints or drawings, locate and name three major components of a typical building cold water distribution system. The three components must be named correctly.

(1) Definition
(2) Components

4b. Using given instructions, make a sketch of the cold water distribution system in the booth area. Sketch must be complete enough to be used to construct the system.

(1) Location of fixtures
(2) Size of lines

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LESSON PLAN (Part I, General) CONTINUATION SHEET

CRITERION OBJECTIVES AND TEACHING STEPS (Continued)

4c. Following the procedures provided, construct a cold water distribution system in the booth area. All measurements must be within ± 1/4 inch of specifications.

(1) Use of tools
(2) Methods of assembly

☆ GPO: 1973 779-388/24

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Course No: 3ABR55235
Days: 22 & 23

Branch Approval:
Date: 22 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 hrs and 10 min)

PRESENTATION:

4a. Using blueprints of drawings, locate the name three major components of a typical building cold water distribution system. The three components must be named correctly.

(1) Definition

(a) Building distribution system- are pipes which conveys water from the building service to the plumbing fixtures and other water outlets.

(b) Building distribution main-that part of the water distribution system which supplies water to the branch lines

(c) Branches-horisontals off distribution main

(d) Risers-Vertical off branches

(e) Air chamber- shock absorber for water

(2) Components

(a) Valves

1 Globe

2 Gate

3 Check

4 Pressure regulating

5 Flush valves

6 Faucets

(b) Fittings

1 Tees

2 Ells 90°

3 Ells 45°

4 Tees, reducing

5 Reducers

6 Bushings

7 Unions

8 Dielectric fittings

9 Couplings

(c) Materials

1 Cast iron

2 Copper

3 Plastic

4 Galvanized

5 Stainless steel

4b. Using given instructions, make a sketch of the cold water distribution system in the booth area. Sketch must be complete enough to be used to construct the system.

(1) Location of fixtures

(a) Water closet

(b) Urinals

(c) Lavatory

(d) Shower

(e) Hot water heater

(2) Size of all lines

(a) Figure the number of fixture to be served by cold water

(b) Figure the number of fixtures to be served by hot water.

(c) Size distribution lines according to total number of fixtures to be served.

APPLICATION:
Accomplish task using WB 3ABR55235-III-4-P1

CONCLUSION (Day 22) (5 Min)

SUMMARY:

STUDY ASSIGNMENT:

SG 3ABR55235-III-4

Course No: 3ABR55235
Day: 23

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

OVERVIEW:

MOTIVATION:

BODY (5 Hr 5 min)

PRESENTATION:

4c. Following the procedures provided, construct a cold water distribution system in the booth area. All measurements must be within ± 1/4 inch of specifications.

(1) Use of tools

(a) Select proper tools

(b) Use tools for right job

(c) Inspect all selected tools for damage

(2) Methods of assembly

(a) Inspect each fitting

(b) Start at the stop and waste valve

(c) Install proper fittings only

(d) Inspect all completed work

APPLICATION: Complete WB 3ABR55235-III-4-P1

EVALUATION: Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (10 Min)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: SG 3ABR55235-III-5

290

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply System

LESSON TITLE
Copper Tubing Assembly (Days 24 and 25)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
12 Hrs	4 Hrs	16 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
35	2 July 1975	5

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	Copper Tubing Copper Fittings	None	SG III-5 WB III-5-P1 thru P5 Film: TF 1-4082 Refrig. and Repair Tube Connections

CRITERION OBJECTIVES AND TEACHING STEPS

5a. Using a working drawing, make a list of the materials required to construct a hot-water distribution system in the booth area. The list must accurately identify all of the required materials without shortages and without excess greater than 10%.

(1) Symbol identifying pipe and fittings
(2) Bill of materials

5b. Following the procedures provided, measure, cut, ream, bend, and flare copper tubing. End-to-center measurements must be within + 1/4 inch of specifications and the flare must completely fill the flare nut without binding.

(1) Measuring techniques
(2) Cutting
(3) Reaming
(4) Bending
(5) Flaring

ATC FORM AUG 72 770

5c. Using the instructions and materials provided, make a swedged connection in copper tubing. Completed swedge must be straight with the tubing and be the depth and diameter of the swedging tool.

(1) Swedging procedures
(2) Preparation of joint

5d. Using given instructions and an acetylene or propane torch, solder a swedged connection. Solder must be visible (in the joint) completely around the tubing.

(1) Soldering procedures
(2) Use of torch

5e. Using given instructions, make a ferruled connection in copper tubing. The finished connection must withstand base water pressure without leaking.

(1) Use
(2) Assembly procedures

Course No: 3ABR55235
Days: 24 & 25

Branch Approval:
Date: 26 August 1975

PART II

INTRODUCTION (45 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW: Administer daily quiz.

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hrs 15 Minutes)

PRESENTATION:

5a. Using a working drawing, make a list of the materials required to construct a hot water distribution system in the booth area. The list must accurately identify all of the required materials without shortages and without excess greater than 10%.

(1) Components

(a) Mains

(b) Branches

(c) Risers

(2) Bill of Materials

(a) Definition

(b) Use working drawing to assist

5b. Following the procedures provided, measure, cut, ream, bend, and flare copper tubing. End-to-center measurements must be within ± 1/4 inch of specifications and the flare must completely fill the flare nut without binding.

(1) Measuring techniques

    (a) End to end

    (b) End to center

    (c) Center to center

(2) Cutting

    (a) Hacksaw - 32 TPI

    (b) Tubing cutter

NOTE: Do not over tighten

(3) Reaming

    (a) Removes burr and restores inside diameter of tubing

    (b) Tools that can be used

        1 Rat tail file

        2 ½ or ¼ round file

3 Reaming blade

(4) Bending

(a) Hard drawn must be annealed

(b) Spring bender

(c) Mechanical bender

1 Prevents kenking

2 Bends angles 180° and under.

(5) Flaring

(a) Plug type flaring tool

(b) Flare cone

(c) Makes a compression joint

5c. Using the instructions and materials provided, make a swedged connection in copper tubing. Completed swedgedmust be straight with the tubing and be the depth and diameter of the swedging tool. 327

- (1) Swedging procedures
  - (a) If hard drawn, tubing must be annealed
  - (b) Tool must be rotated after being struck
- (2) Preparation of joint
  - (a) Clean male and female ends
  - (b) Apply flux
  - (c) Solder

5d. Using given instructions and an acetylene or propane torch, solder a swedged connection. Solder must be visible (in the joint) completely around the tubing.

- (1) Soldering procedures
  - (a) Solder melts at 360°
  - (b) Free flows at 415°
- (2) Use of torch

5e. Using given instructions, make a ferruled connection in copper tubing. The finished connection must withstand base water pressure without leaking.

(1) Use

(a) Quick to assemble

(b) Compression joint

(2) Assembly procedures

APPLICATION:

Have students accomplish WB 3ABR55235-III-5-P3

EVALUATION:

Evaluate by oral, written questions and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (10 Min)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT:

Read and answer questions on SG 3ABR55235-3-6.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE B R Carrington TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply System

LESSON TITLE
Water Supply Rough-in for Fixtures (Day 26)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
6 Hrs	2 Hrs	8 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
37	2 July 1975	6

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools	Galvanized Pipe Galvanized Fittings	None	SG III-6 WB III-6-P1 Rough-in Specifications Engineers Drawings Slides: Water Supply Rough-in for Lavatory, Urinals, and Water Closets.

CRITERION OBJECTIVES AND TEACHING STEPS

6a. Using a plumber's sketch and manufacturer's rough-in specifications, make a list of the materials required and determine the procedures necessary to install the water supply for both area fixtures. The bill of material must accurately identify all of the required materials without shortages and without excess greater than 10%

(1) Fixtures
(2) Materials

6b. Using given instructions, rough in the water supply for the fixtures in the booth area, installing air chambers and electrical insulating fittings as required. The water supply must be ready for the fixture. The air chambers must eliminate the possibilities of water hammer and the insulating fitting must be installed correctly.

(1) Rough-in measurements
(2) Safety

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Course No: 3ABR55235
Day: 26

Branch Approved:
Date: 28 August 1975

PART II

INTRODUCTION (40 Minutes)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (5 Hrs 15 Min)

PRESENTATION:

6a. Using a plumber's sketch and manufacturer's rough-in specifications, make a list of the materials required and determine the procedures necessary to install the water supply for both area fixtures. The bill of material must accurately identify all of the required materials without shortages and without excess greater than 10%.

(1) Fixtures

(a) Shower

(b) Urinal

(c) Lavatory

(d) Water closet

(e) Hot Water Heater

(2) Material

(a) Pipe

(b) Fittings

(c) Valves

NOTE: Explain each

6b. Using given instructions, rough in the water supply for the fixtures in the booth area, installing air chambers and electrical insulating fittings as required. The water supply must be ready for the fixture. The air chambers must eliminate the possibilities of water hammer and the insulating fitting must be installed correctly.

(1) Rough-ins measurements

(a) Take all measurements from finished wall

(b) End to End

(c) End to center

(d) Center to center

(2) Safety

(a) Use caution while operating power threader

(b) Always pull on pipe wrenches

(c) Wear gloves when checking threaded pipe

APPLICATION:

Complete WB 3ABR55235-III-6-P1 and make a material list for installing booth fixtures.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. This may be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (5 Min)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Read SG 3ABR55235-III-7 and answer the questions at the end of the text.

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE TCETC/22Aug75	INSTRUCTOR
COURSE NUMBER 3ABR55235	COURSE TITLE Plumbing Specialist
BLOCK NUMBER III	BLOCK TITLE Exterior and Interior Water Supply System

LESSON TITLE
Installation of Domestic Water Heaters (Day 27)

LESSON DURATION

CLASSROOM/LABORATORY	COMPLEMENTARY	TOTAL
4 Hrs	2 Hrs	6 Hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
38	2 July 1975	7

STS/CTS REFERENCE

NUMBER	DATE
552X5	15 February 1973, Chg 1, 25 Feb 1974

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hand Tools Shop Tools Water Heaters	Copper Fittings Galvanized Fittings Copper Tubing	None	SG III-7 WB III-7-P1 Rough-in Specifications Slides: Water Heaters

CRITERION OBJECTIVES AND TEACHING STEPS

7a. Using the diagram provided, locate and name the major components of gas and electric water heaters. The eight components of the gas burner and nine components of the water heater must be named correctly.

(1) Types of heaters
(2) Construction features

7b. Install and light a gas water heater. The piping must not leak and the air-gas mixture must be adjusted to produce a blue flame with a yellow tip.

(1) Burner assembly
(2) Lighting procedures

ATC FORM AUG 72 770

Course No: 3ABR55235
Day: 27

Branch Approval:
Date: 28 August 1975

PART II

INTRODUCTION (45 Min)

CHECK PREVIOUS DAYS STUDY ASSIGNMENT

REVIEW:

ATTENTION:

OVERVIEW:

MOTIVATION:

BODY (3 Hrs and 5 Min)

PRESENTATION:

7a. Using the diagram provided, locate and name the major components of gas and electric water heaters. The eight components of the gas burner and the nine components of the water heater must be named correctly.

(1) Types of heaters

(a) Gas heaters

(b) Electric heaters

(2) Construction Features

(a) Gas fired

1 Sheet steel casing

2 Heat seal insulation

3 Cold water drop tube

4 Heat deflector

5 Flue

6 Instant action temperature control

7 Safety gas control valve

8 Draft divertor

9 Drain cock

10 Fast recovery cycle

11 Relief valve

(b) Electric heater

1 Sheet Steel casing

2 Heat seal insulation

3 Cold water drop tube

4 Quite operation

5 Clean operation

6 Relief valve

7 Upper thermostate

8 Lower thermostate

9 Drain cock

10 Upper heating clement

11 Lower heating

7b. Install and light a gas water heater. The piping must not leak and the air-gas mixture must be adjusted to produce a blue flame with a yellow tip.

(1) Burner Assembly

(a) Main gas control valve

(b) Thermostate adjusting valve

(c) Air shutter

(d) Main burner

(e) Thermocouple

(f) Pilot light

(g) Combination Safety Valve

(2) Lighting Procedures

(a) Fill heater with water

(b) Turn indicator knob to pilot position

(c) Light match

(d) Depress indicator knob

(e) Apply match to pilot light tip

(f) Hold indicator knob down for on minute

(g) Release indicator knob

(h) Turn indicator to on position

(i) Check flame for proper height and color

NOTE: Flame should be a soft blue with the tip of flame light yellow.

APPLICATION:

Complete WB 3ABR55235-3-7-P1.

EVALUATION:

Evaluate by oral, written questions, and/or observation of student's performance during lesson. Thismmay be accomplished at any time during lesson for increased effectiveness.

CONCLUSION (10 Minutes)

SUMMARY:

REMOTIVATION:

STUDY ASSIGNMENT: Read SG 3ABR55235-III-9, Answer questions at end of text and review for measurement test over Block III.

STUDY GUIDES 3ABR55235-III-1 thru 7

Department of Civil Engineering Training

Plumbing Specialist
Block III

EXTERIOR AND INTERIOR WATER SUPPLY SYSTEMS

2 December 1974

SHEPPARD AIR FORCE BASE

Designed For ATC Course Use

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TABLE OF CONTENTS

Unit	Page
3ABR55235-III-1	1
3ABR55235-III-2	9
3ABR55235-III-3	19
3ABR55235-III-4	29
3ABR55235-III-5	33
3ABR55235-III-6	41
3ABR55235-III-7	53

This supersedes SG 3ABR55235-III-1 thru 7, June 1973 (Copies of the superseded publication may be used until the supply is exhausted.)

Department of Civil Engineering Training
Sheppard Air Force Base, Texas

SG 3ABR55235-III-1
2 December 1974

EXTERIOR WATER SUPPLY

OBJECTIVE

The purpose of this study guide is to aid you in learning the configuration and principles of operation of water distribution systems.

INTRODUCTION

The society we live in today thrives on the availability of all things to the members' immediate demand. Individual water barrels are out and mass distribution systems are in.

Water distribution systems may be simple or complex. Engineer drawings become guides and maps for the plumber. Many systems may be included in the same drawings. Correct interpretation of such maps eliminates errors in determining materials required, systems construction, and design configuration.

WATER DISTRIBUTION SYSTEM COMPONENTS

Carefully planned water distribution systems resemble a grid. A network of large piping divides the consumer area into subareas. Each subarea is served by a network of smaller piping. Such systems are often referred to as belt or loop systems. There are no dead ends and water can flow to any point in this system from two or more directions. Further, additions to the system will not dilute its functional capability. Figure 1 illustrates a simple water distribution system.

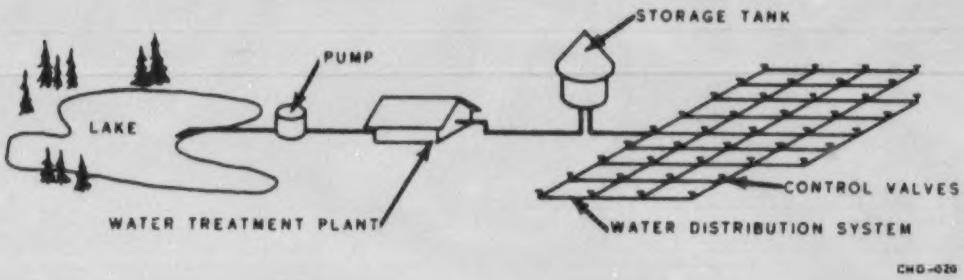


Figure 1. Water Distribution System

Components

Components in water systems vary depending on the water source, its location in relationship to the user, and water characteristics.

Pumps

Pumps may be required at Air Force installations to pump water from lakes, reservoirs, or rivers to a water treatment plant. After treatment additional pumping forces water into the mains and storage facilities. In distribution systems booster pumps may be used to increase water pressure. Emergency pumps are used in case of water supply breakdown or to satisfy firefighting requirements. When pumps are installed in a main or service line, they should be connected to the piping by unions or flanges. This allows for easy removal of the pumps from the system during maintenance or when the pump needs to be replaced.

Treatment Plants

Absolutely pure water is never found in nature. For military use, water must be free of disease-producing organisms, poisons, and excessive amounts of mineral or organic matter. All water treatment plants do not contain the same equipment. They are designed according to the amount and type of minerals and organic matter the water contains. So no two plants will be the same. But they will have the same discharge of water whenever possible.

Storage Tanks

The normal water demand in a community or military installation varies considerably between night and day and for different days of the week. During low demand periods, treated water is stored in storage tanks. Treated water from the storage tank is fed back into the system when the demands exceed the capacity of the supply source or treatment plant. Storage tanks also provide an emergency water source should a failure occur in the system or for firefighting. Storage tanks may be at ground level or higher than the portion of the system they serve. Reservoirs or storage tanks higher than the distribution system maintain the desired pressure in the system.

Valves

Valves are used in the water distribution system to control the flow of water. The different types of valves include gate valves, pressure reducing valves, check valves, curb service valves, globe valves, and fire hydrants.

Breaks and leaks can be caused by freezing, ground movement, collision, fire, excessive water pressure, and explosion. Gate valves placed at strategic points in the system must be closed, thereby isolating the damaged area. Service to the undamaged portion of the system will continue without being interrupted.

Globe valves are used in the distribution system on small lines or service lines. They restrict the flow and cannot be used where flow restriction is not needed.

Check valves will prevent reversal of water flow due to loss of pressure. Check valves will also isolate certain sections of the distribution system.

Pressure-reducing valves throttle the flow in pipes to reduce the pressure on the discharge side and keep it constant. They are used for feeding water from a high-pressure to a low-pressure system. If great variations in flow rates are expected, different sizes of pressure reducing valves will be installed in batteries.

Curb service valves control water distribution to individual buildings or dwellings. These will be used as the need for water to the buildings is determined.

Fire hydrants will be placed in all areas where there is a need for fire protection. Proper operation and use of hydrants is essential to water distribution economy and safety. All fire hydrants should have a gate valve serving as a positive shutoff in case of damage to the hydrant.

Piping

Mains and piping are composed of feeder mains, distribution mains, branch or lateral lines, and service lines. The feeder mains are large pipe and supply distribution mains and storage tanks.

Distribution mains are the pipelines which make up the distribution system and include any lateral or branch lines from which service lines take their supply.

Service lines transport the water from the distribution mains to the various buildings and facilities.

The lateral lines will make the distribution system more effective and efficient by forming a closed loop system.

With the exception of the fire hydrants and some storage tanks, the water distribution system is underground. It is more practical to bury a large portion of the distribution system to protect it from damage from weather and collision.

Maps and Records

An important prerequisite for any good operating distribution system is a good set of maps and records. The maps should show the location and size of all valves, pipes, and other components. The records should be an accurate account of all repair and maintenance performed on the system. The maps and records must be updated each time a repair or maintenance function is performed. Out of date records are worthless.

FACTORS GOVERNING WATER MAIN CONSTRUCTION

Quantity Needed

The amount of water needed by an air base will depend on several factors. The effective population, which is all the residents living in the dormitories or in government housing, must be furnished domestic water.

At the beginning of each workday the civilians that work on the base start arriving. These nonresidents help make up the authorized population of the base. Water must be furnished so each may do his job properly.

Some bases have large hospitals. Hospitals use large amounts of water. Bathing of patients, mopping floors, kitchen uses, and hospital laundries are some of the uses.

1E- 75-R02

The amount of water used by a base will vary both day and night and summer and winter. If a large fire occurs and the firetrucks have to pump water all night, then the base could run low on water supply. This would be called an unusual peak demand.

Firefighting has to be taken into account when the base is first built so enough water will be on hand if needed. If the base grows, more water towers are needed.

Quality Needed

There are two types of water consumed on a military base. They are domestic and industrial.

DOMESTIC WATER. Every base must have water that is clear, have an acceptable taste, and be free of bacteria. When water meets these requirements, it is called POTABLE water.

Even though water is potable, there are some things that make it undesirable for domestic uses. These are odors and hardness. Odors come from sour gases in the water or from minerals such as sulphur.

Some water forms a white scale on the walls of water glasses, pipes, and anything where the water can evaporate. This white scale signals the hardness of water. When water contains too much hardness, the water must be softened. This is accomplished in the water treatment plant.

Industrial Uses

Do you remember seeing water trickling down a large cooling tower? This is industrial water. There are two common uses for industrial water on an Air Force installation. Water to furnish Air Force operating equipment and heated water for sanitation purposes.

Hospitals need pure water for mixing medicines, so they use distilled water. Airplanes use pure water to squirt in the engines for more power. The water they use goes through a demineralizer which removes minerals from the water.

Boilers that heat large amounts of water for laundries use specially treated water to prevent a white scale from covering the insides of the boilers.

1B- 75-802

METHODS OF ASSEMBLING PIPE JOINTS

Lead Caulked Joints

Leak caulking is used on cast-iron water pipe. The pipe is available in a variety of sizes, lengths, wall thickness, and hub depths. Cast-iron water piping should not be confused with cast-iron soil pipe.

Lead caulking is the most common method of assembling bell-and-spigot type joints. The spigot end of the pipe is inserted in the bell or hub of the receiving pipe. Oakum is firmly packed into the area between the hub and spigot end of the pipe with a spigot tool. The amount of oakum is firmly packed into the area between the hub and the spigot end of the pipe with a special tool. The amount of oakum applied varies with the size and depth of the hub. The remaining hub depth is filled with molten lead. The lead is tamped and dressed with specially designed tools. These tools are similar to the tools used to fabricate soil pipe.

Sulfur Joints

Sulfur joints are assembled and poured in the same manner as lead-caulked joints. The oakum is applied and the sulfur is heated to a liquid state and poured into the joint. No tamping is required once the sulfur cools.

Sleeved Coupling

A sleeved coupling resembles a can with both ends removed. The cylinder is internally grooved to accommodate rubber O-rings as the pipe is forced into the sleeve. Figure 2 shows pipe ends and sleeve assembled.

The sleeve coupling is also used to assemble cement asbestos pipe joints. The pipe may be adaptable to cast-iron piping by a lead-caulked joint.

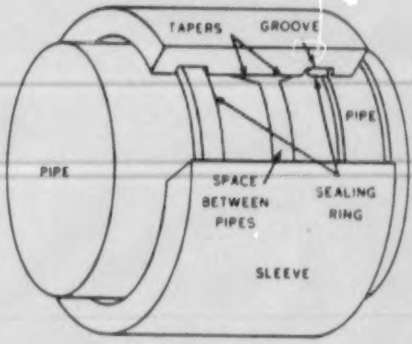


Figure 2. Sleeve Coupling

Screwed Joints

A screwed joint is used to assemble steel pipe. It requires an internally threaded fitting to be mated with a matched externally threaded pipe. A pipe compound is applied to the external threads to lubricate the threads, aid in forming a seal between the thread surfaces, and to provide an antiseize for easier disassembly. Normally you do not use screwed joints on large pipe.

Flange

The flange joint, as shown in figure 3, has proven its general utility and satisfactory performance. It is used in the installation of pumps, chillers, heat exchangers, and other equipment. The flange itself is molded separately from the pipe. The flange is attached to the pipe by a screwed connection or by welding. A gasket is used between the flanges to form a seal, then bolted securely together to form a water- or gas-tight connection.

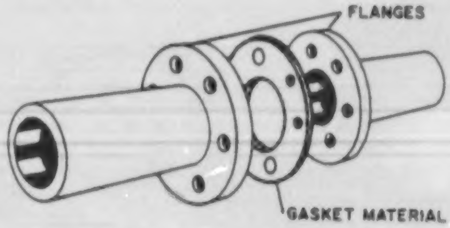


Figure 3. Flange Fittings

Plastic

Plastic pipe can and is often used for service lines. Some of its advantages are that it is easily connected to copper tubing or pipe, it is lightweight, withstands corrosion, low cost, and easy to work with and use. Plastic tubing or pipe is available in sizes from 1/4 to 8 inches in diameter.

Connecting Pipe to Pumps

A variety of pumps are used throughout plumbing systems. Three common methods of connecting pipes to pumps are threaded connections, flanged connections, and mechanical coupling.

On pumps requiring threaded connections, there is a short nipple screwed into the pump. One side of a union is screwed on the nipple while the other side of the union is screwed on the pipe. The connection is completed by joining the two halves of the union.

SUMMARY

Water distribution systems are constructed in loops so that water may reach any point from at least two directions. Valves in the system are used to isolate portions of the system, control waterflow, or reduce pressure at strategic points.

Aside from the distribution system itself, the inclusion of other units, such as storage tanks, pumps, and treatment plants, depends on the water source, location relative to user, user demand, and water characteristics.

Steel, cast-iron, or steel and cement asbestos pipe are used for water main construction.

Threaded or screwed joints, lead-caulked joints, sleeved joints, and flanged joints are methods of assembling water main piping joint.

Plumbing systems are laid out on maps and each unit identified by a symbol. Maps are used by both construction and maintenance crews as references.

QUESTIONS

1. What is meant by a loop water distribution system?
2. What is the function of the gate valve on a water system?
3. Name the components of a water distribution system.
4. Why is it important to have maps of a water distribution system?
5. Name the types of pipe used in a water system.
6. When installing a pump, what important item must you remember?
7. What is the function of a check valve?
8. What is the purpose of the curb service valve?
9. Name the two types of water needed on a military installation.
10. What does the term "Quantity and Quality" mean when speaking of water demands?

REFERENCES

1. AFM 85-13, Maintenance and Operation of Water Plants and Systems.

2. AFM 85-20, Plumbing.

STEEL PIPE ASSEMBLY

OBJECTIVE

The purpose of this study guide is to introduce the procedures used in preparing and assembling steel pipe.

INTRODUCTION

Steel piping is often used for building service and distribution systems. Installing the system requires correct measuring, cutting, and threading techniques to make the system watertight.

PIPE CUTTING, REAMING, AND THREADING TOOLS

Pipe is not always the length required for system fabrication. It must be cut to the desired length and threaded. There are several tools available to the plumber to accomplish each operation. For discussion purposes, this study guide will identify the tools as either hand-operated or power-operated.

Holding Devices

Pipe must be securely supported if cutting is to be accurate. Special holding devices have been developed to hold pipe. The devices, called pipe vises, are available in a variety of sizes and designs. Vises may be hand-operated. Larger vises may also be power-operated. The vise jaws are tightened on the pipe, holding it in place. Vises may be permanently installed or may be mounted on a platform with legs making it a "portable" tool. Figures 4, 5, and 6 show some of the vises available for the plumber's use. When holding soft metal pipe, such as brass or copper, a lead sleeve is placed over the jaws of the vise to protect the pipe from being scratched or marred by the vise jaws.

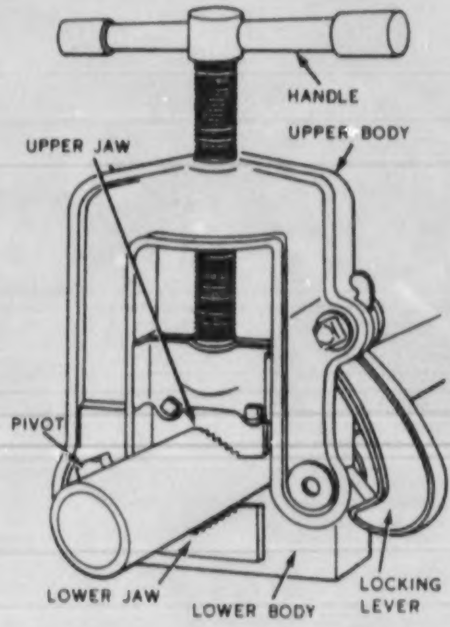


Figure 4. Bench Vise

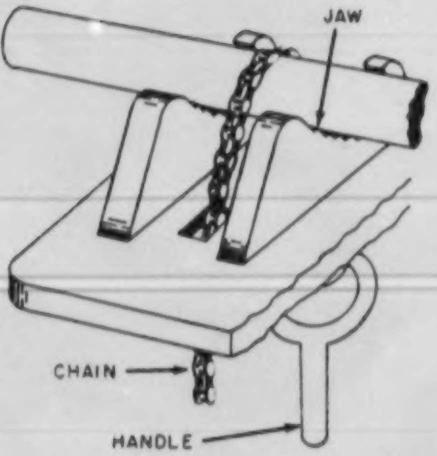


Figure 5. Chain Vise

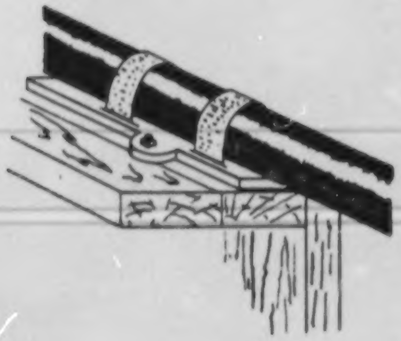


Figure 6. Strap Vise

Pipe Cutters, Hand-Operated

Figure 7 illustrates a hand-operated pipe cutter. Pipe cutters are available in several sizes and designs. Some are designed to cut pipe where a complete revolution around the pipe cannot be made. The pipe cutter in figure 7 requires a full revolution around the pipe for cutting. To use the pipe cutter, place the cutter wheel on the point where the pipe is to be cut and tighten rollers snugly against the pipe. Rotate the pipe cutter around the pipe. Tighten the cutter 1/4 turn after each revolution around the pipe.

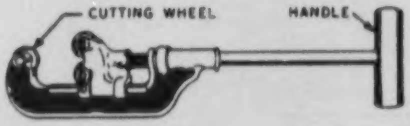


Figure 7. Pipe Cutter

Support the pipe end being cut and maintain a hold on the cutter as the cut nears completion. Injury may result from the falling pipe and cutter. The cutter may also be damaged.

Hacksaw

A hacksaw, similar to the one illustrated in figure 8, may be used to cut pipe. Its use produces a rough end cut with considerably less accuracy than the pipe cutter.

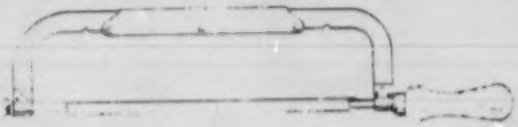


Figure 8. Hacksaw

A variety of blades are available for cutting purposes. A hard tempered blade is best for cutting hollow shapes and lightweight metals, such as tubing, tin, or copper.

The wall thickness and type of pipe being cut not only affects the type of blade selected, but also the number of teeth per inch on the blade. In general, best results are obtained by using a fine blade (32 teeth per inch) on thin-walled tubing. A coarse blade (18-24 teeth per inch) is used for thicker walled piping.

The blade should be installed in the frame with the teeth pointing away from the handle. Cutting is then accomplished by applying slight pressure on the forward stroke. Pressure must be released on the return stroke to prevent teeth damage. Excessive pressure used to cut metals faster will only damage the blade and require early replacement. Thin-walled materials may be ripped or deformed.

Goggles should always be worn when cutting pipe above or at shoulder level.

Reamers

Piping systems are designed to offer minimum resistance to liquids flowing through them. One item of resistance occurs when a burr is left in a cut pipe, figure 9.

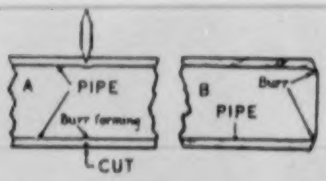


Figure 9. Burr Resulting from Cutter

Burrs should be removed by filing them off with a rattail file, as shown in figure 11, or with a tool specially designed for the job, as shown in figure 10 (Reamer). Reaming is accomplished before threading pipe.

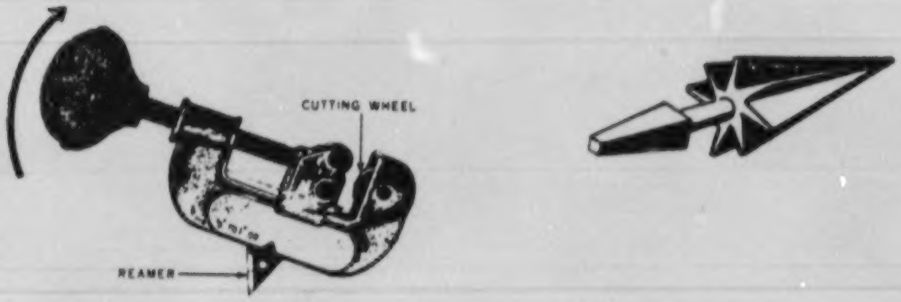


Figure 10. Pipe Reamers

Files

The outside surface of a pipe is often marred through normal handling. If nicks and burrs are near the end of the pipe, they must be removed before the pipe is threaded. A variety of files shown in figure 11 may be used for this purpose.

Filing is accomplished in the same manner as cutting with a hacksaw. Slight pressure is applied on the forward stroke only. Occasional cleaning with a file brush, sometimes called a file card, is required to clear clogged teeth.

A handle should always be used with the file to reduce possible injury to the user.

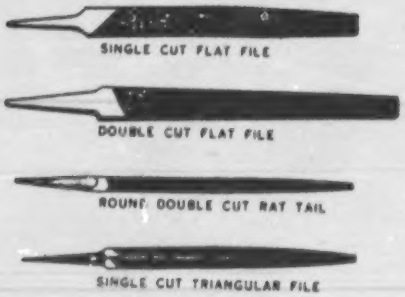


Figure 11. Files

Threading Pipe

A stock and die set of the nonadjustable type may be used to thread pipe by hand. A set of dies, as illustrated in figure 12, are used with the same die stock. Larger die sets require larger diestocks.

An adjustable die and stock set eliminates the need for changing dies when threading different size pipe.

The die, as shown in figure 13, is a tool with cutting edges. The die is aligned on the pipe. The first threads are shallow and incomplete. As the die is turned on the pipe, the threads become deeper and more completely formed (figure 14).

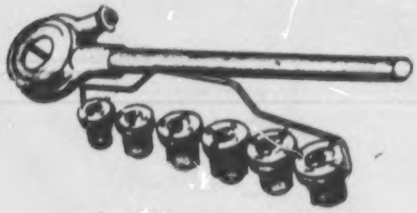


Figure 12. Die and Stock Set

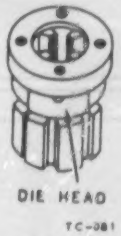


Figure 13. Die

The areas between the cutting segment permit shavings to be expelled A good grade cutting oil is applied after each revolution. This cools, cleans, and lubricates the cutting threads. Die segments should be kept clean and properly set before threading in order to prevent damage to the die segments and the pipe threads.

SIZE OF PIPE	NUMBER OF THREADS PER INCH	TOTAL LENGTH OF THREADS (___)
1/4 - 3/8	18	5/8"
1/2 - 3/4	14	13/16"
1 - 1/2	11 1/2	1"
2 1/2	8	1 9/16"

Figure 14. Pipe and Thread Sizes

It is considered unsafe to quickly spin the die off the threaded pipe. Damage to both die and threads on the pipe may result. Personal injury may also result if the die comes off the threaded pipe sooner than expected.

Pipe Threads

Standard pipe threads are used for all pipes and fittings. Threads are identified by number per inch. Eight peaks or threads in an inch indicates that there are eight threads per inch. The number of threads per inch is determined by pipe size. The chart in figure 11 lists the threads per inch for each pipe size. The normal length of the threaded portion of the pipe is also listed. However, a general rule is to thread enough pipe to expose at least two full thread revolutions beyond the die.

Power Threading Tools

To be able to cut, ream, and thread pipe with power tools is a great time-saver. It can be dangerous if the operation is not performed properly.

There are many types of threading machines. The most common are the power bench threader, power-driven vise stand, and the geared type threader.

Power-Driven Bench Threader

Figure 15 illustrates a power-driven bench threader. Most plumbing shops are equipped with this type threader. Two-inch pipe is the largest pipe this machine will handle.

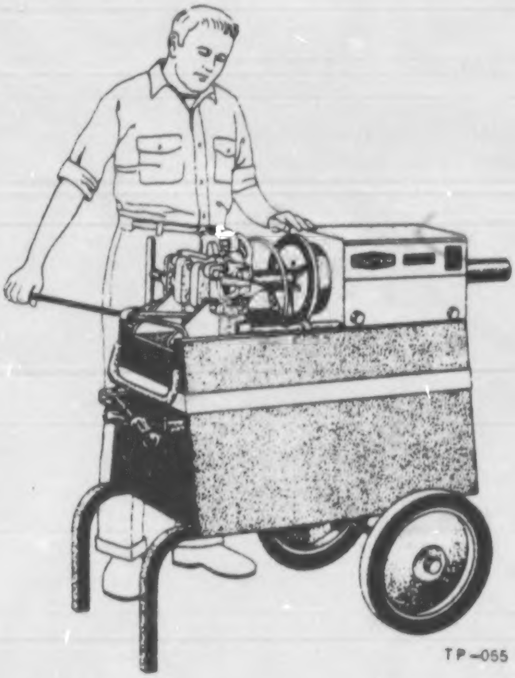


Figure 15. Power-Driven Bench Threader

Pipe is inserted and secured in a rotating chuck. An individual cutter, reamer, and threader can be applied without stopping the machine.

An oil pump and jet directs oil on the cutting surface at all times. Metal chips and files are washed off the pipe and collected in a reservoir. Routine cleaning is all that is required to maintain the machine in working order.

Gear-Type Threader

A geared-type threader is used to cut pipe larger than 2". The pipe is held securely by a portable chain vise. The threader is installed on the pipe end and the proper size cutting segments installed. The cutter housing is secured to the pipe by means of setscrews.

Power to turn the cutting segments may be supplied by the portable power threader (as shown in figure 16) or by a vehicle equipped with a power takeoff. A drive shaft connects the geared threader to the power source. The geared type threader may also be worked by hand with a special wrench and adapter.

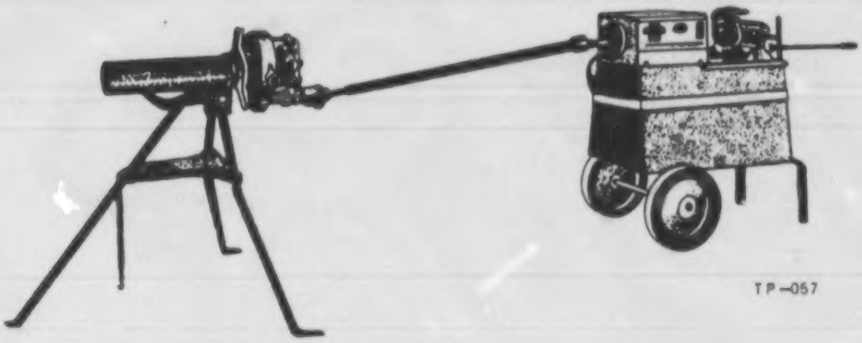


Figure 16. Portable Power Threader

Power-Driven Vise Stand

A power vise stand (illustrated in figure 17) is also a common machine used in plumbing shops and on the job. Simply speaking, it is a rotating vise.

Once the pipe is installed in the vise, cutting, reaming, and threading pipe can be accomplished. Rotating power is provided through reduction gears connected to an electric motor. Bars extending on each side, provide a rest for the handles of pipe cutters, threaders, and reamers.

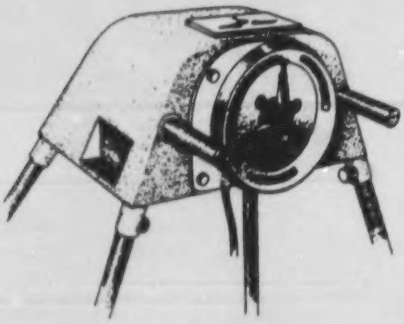


Figure 17. Power-Driven Pipe Threading Machine

The portable vise stand will only handle pipe up to 2" in diameter. Larger pipe must be threaded by the geared type threader shown in figure 17. However, the portable power vise may be the power source.

> NOTE: Cutting, reaming, and threading pipe with power machinery can become a common operation. It can become such a routine operation that a plumber can "do it blindfolded" so to speak. Such concepts have caused serious injuries to the machine operator. Arms have been broken by rotating handles. Feet have been fractured by falling pipe. Serious injuries have been sustained when an operator has been drawn into the machines. This has been caused when clothes become caught in the moving machine parts.

MEASUREMENT

There are three methods of measuring pipe for cutting and threading; end-to-end measurements, center-to-center measurements, and end-to-center measurements (see figure 18). These methods must be understood if pipe is to be cut to the correct lengths.

End-to-End Measurement

End-to-end measurement is the measurement from one end of a piece of pipe to the other end. It is the full length of the pipe including the thread.

Center-to-Center Measurement

Center-to-center measurement is used only when a length of pipe has a bend fitting screwed on both ends. The center-to-center measurement is the measurement from the center of the outlet of one fitting along the pipe to the center of the outlet of the opposite fitting.

End-to-Center Measurement

End-to-center measurement is used for a piece of pipe having a bend fitting screwed on one end only. The end-to-center measurement is the measurement from one end of the pipe, including the thread, to the center of the outlet of the bend fitting on the other end.

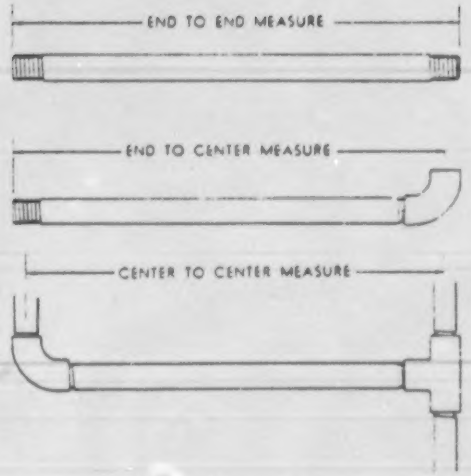


Figure 18. Pipe Measurement

JOINING THREADED PIPE

Before assembling a section of pipe with a fitting, clean chips and dirt from the threads of both items with a stiff bristle or wire brush. Then inspect the threads to determine that they are clean and properly cut. Coat the male threads of the pipe evenly with pipe-joint compound. Start the fitting on the male thread of the pipe by hand, exercising care not to cross the threads. Apply a pipe wrench to the fitting and tighten it on the pipe until the joint is made up to the desired degree of tightness. The pipe wrench should be placed on the shoulder of the fitting which is on the end of the fitting being connected. If the wrench is applied to any other part of the fitting, distortion of the fitting may be caused and result in a leaking joint. Generally, two wrenches are needed to tighten the joint, one on the pipe and the other on the fittings (see figure 19).

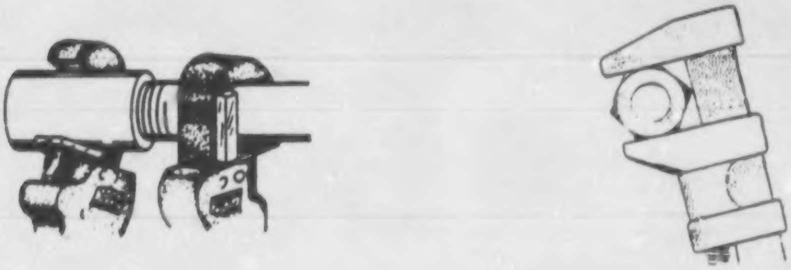


Figure 19. Using Wrenches

Most beginners use excessive strength when screwing fittings or valves on pipe. This is poor practice because not only does it waste energy but excessive strength will stretch fittings. Once a fitting is stretched it will leak and have to be removed and replaced.

To prevent excessive tightening, the size pipe wrench to be used for the several pipe sizes are as follows:

6 inch wrench for 1/8" pipe
8 inch wrench for 1/4" pipe
10 inch wrench for 3/8" and 1/2" pipe
14 inch wrench for 3/4" and 1" pipe
18 inch wrench for 1 1/4" and 1 1/2" pipe
24 inch wrench for 2" pipe

SUMMARY

Cutting, reaming, and threading pipe are common operations performed daily by plumbers. These operations may be accomplished either by hand or with power tools.

Pipe may be cut either by the use of a standard pipe cutter or a hacksaw. Cutting pipe with a pipe cutter is the preferred method. Cutting with a pipe cutter will cause a burr to form on the inside of the pipe. This burr must be removed since it hinders the flow of liquids and causes stoppages. The time to remove it is immediately after the pipe is cut. A pipe reamer is used to remove the burr. The reamer is a fluted unit which is placed in the end of the pipe and turned clockwise. The turning action cuts off the burrs.

After the pipe is reamed, it is ready to be threaded. Pipe may be threaded by the use of various types of threaders. Threading may be accomplished with either handtools or power tools. The pipe must be held rigidly in a pipe vise and the dies properly placed on the pipe and turned clockwise to make a good thread. Plenty of cutting oil should be used during the threading operation to keep the die segments cool and prevent them from chipping. A sufficient number of threads have been cut on the pipe when about two threads extend beyond the die segments.

Care should be taken when working around power-driven machinery to avoid accidents. Do the job step-by-step as if it were the first time you have ever attempted to do it. Just because you are using a power-driven machine and you do not see the power exerted by the machine, this does not mean you cannot have an accident. Many a plumber has lost a finger or broken his arm by becoming careless and allowing his loose sleeve to get caught in a set of revolving dies. Remember to keep your sleeves and clothes properly buttoned when you are working around any power-driven equipment.

QUESTIONS

1. What two methods may be used to cut pipe?

2. Why is it necessary to ream pipe before it is threaded?

3. How is pipe reamed?

4. Why is a lead sleeve used to hold brass, copper, and chromium pipe in a vise?

5. How do you know when the proper thread length has been reached?

6. Why is cutting oil used during a thread cutting operation?

7. What equipment is used to cut threads on pipe?

8. Why should dies be cleaned and properly set before a threading operation?

9. What safety precautions should be followed when threading pipe?

10. Why should pipe be supported when it extends beyond a power threading machine?

REFERENCES

1. AFM 85-20, Plumbing

2. National Plumbing Code

INSTALLATION OF BUILDING SERVICE LINES

OBJECTIVE

To develop your knowledge of procedures, specifications, and materials used in the installation of building service main.

INTRODUCTION

The building service main is a short, rather uncomplicated system connecting the building water system to the street main. The AF plumber is often called on to repair the system or to fabricate and install a new system. This not only requires the plumber to know what is in the system but also how large the pipe must be, where they must be installed, and how to connect the system to the street main.

BUILDING SERVICE MAIN

System Design

The building service main is the part of the water distribution originating at the street main and extending into building. The piping is buried below the frostline to protect it from freezing.

Excessive turns and offsets create friction to water movement which in turn affect water pressure and flow. The building service main must, therefore, be as short and straight as practical.

Figure 20 illustrates a typical service main. Individual components are discussed in paragraphs to follow.

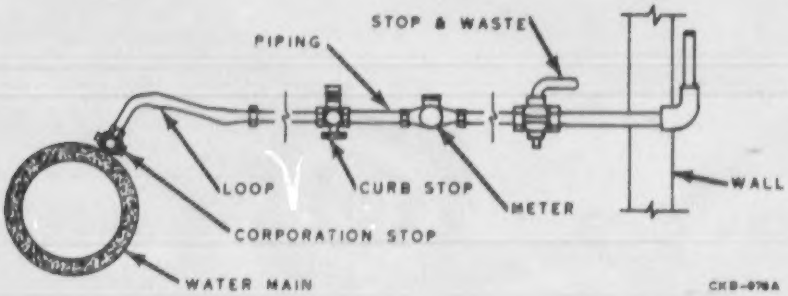


Figure 20. Typical Service Main

Piping

Either copper, galvanized steel, or plastic piping can be used for servicing small buildings. Cast-iron pipe is favored for larger buildings.

The size of the building, however, is not the determining factor in selecting the size of pipe used in constructing the service main. There are a number of variables that enter into the computations in determining the maximum requirement for water in a building such as the number and type of fixtures, the size of the lawn, climatic conditions, and the number of occupants. Local regulations must also be considered.

Pipe joints used in the service main are consistent with the type of pipe used. Soldered and flared joints are used for copper pipe assembly while cast-iron joints are lead calked. Steel piping is assembled by threaded connections.

Corporation Stops

A corporation stop is threaded directly into the main after the tap has been made (see figure 21). This serves as a shutoff until the curb stop and the service up to that point has been installed.

Once the service line is installed, the corporation stop is used only when repairs to the line between the main and curb stop are necessary. Figure 21 illustrates a corporation stop.

Due to the location of water mains (usually under center of street) and in view of the fact that the corporation stop is very seldom shut off, no boxes or extension rods to the surface of the ground are installed.

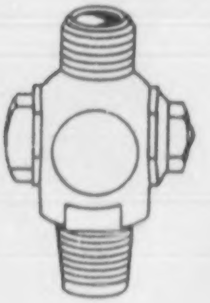


Figure 21. Corporation Stop

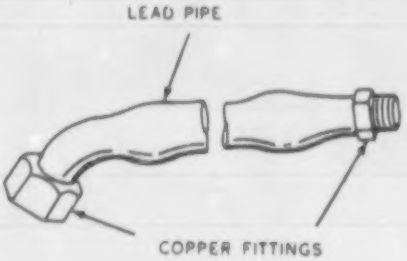


Figure 22. Gooseneck

Flexible Connections

Flexible connections are used to absorb street vibrations and compensate for ground settling and shifting. The gooseneck as shown in figure 22 and the swing joint shown in figure 23 are two types of flexible joints.

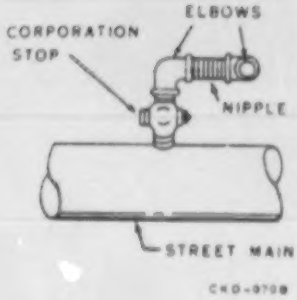
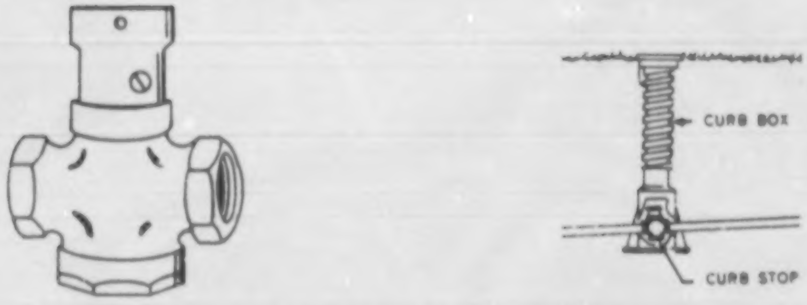


Figure 23. Swing Joint

Curb Stops

Curb stops are placed in the line at a convenient place between the street curb and the property line. The curb stop (figure 24A) is covered by a curb box (figure 24B) with an extension to the surface so that the valve may be opened or closed. A long key on a rod extension from the top provides a means of reaching the curb stop from the surface. Curb stops are particularly valuable in cold climates where a building may be vacant during the winter months. Water service is shut off as a safeguard against frozen waterlines within the building or possible loss of water through leaky pipe and fittings.



A. Curb Stop

B. Curb Box

Figure 24

Meter Stop

A valve placed on the street side of a meter on the service line is called a meter stop (figure 25). Their purpose is to shut off the water when the meter is removed. In some installations it is used as the controlling stop to the building.

Watermeter

A watermeter is a device used to measure the amount of water passing through it (figure 26). Plumbers may use such a device when

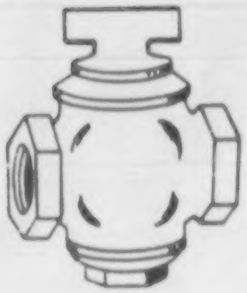


Figure 25. Meter Stop

determining water consumption in various locations on the base. When a base buys its water from the local municipality a meter is used to measure the amount used. Off-base water customers are accessed charges for water service based on the amount of water passing through the customers' meter.

The meter is a precision instrument and should be handled with care. It may be installed outside or inside the building.

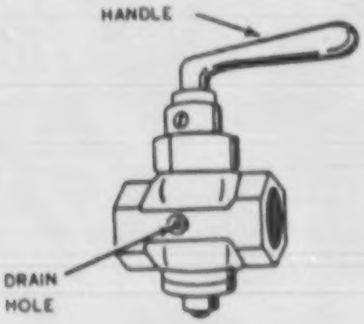


Figure 27. Stop and Waste Valve

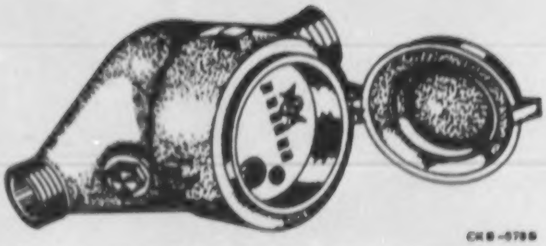


Figure 26. Watermeter

Stop and Waste Valve

In some installations a valve may be installed either inside or outside the building in the service line. It is often the shutoff valve to the building. It is a unique valve in that when it is turned off, water from the building water system is drained off through ports in the valve body (see figure 27). Building water systems can be drained for wintertime protection when not in use and also to facilitate system repairs.

TAPPING THE STREET MAIN

The location of buildings requiring water service are not always identified when the street mains are laid. The street main must, therefore, be tapped and a corporation stop installed.

A self-tapping machine and specially designed corporation stop has been developed to enable the plumber to tap and install a corporation stop without interrupting water service in the main, figure 28. The pressure in the main must not exceed 90 psi unless a special attachment called a "power clevis" is used to control the withdrawal of the boring bar. The "power clevis" prevents damage to the self-tapping machine due to shock caused by the uncontrolled upward motion of the boring bar. Using this attachment the main may be tapped under a maximum pressure of 200 psi. If the pressure exceeds 200 psi it must be reduced before tapping.

If the building service line is more than 1/4 as large as the main, construct a manifold assembly. This includes making a series of taps on the main and connecting them together to the building service line as shown in figure 29.

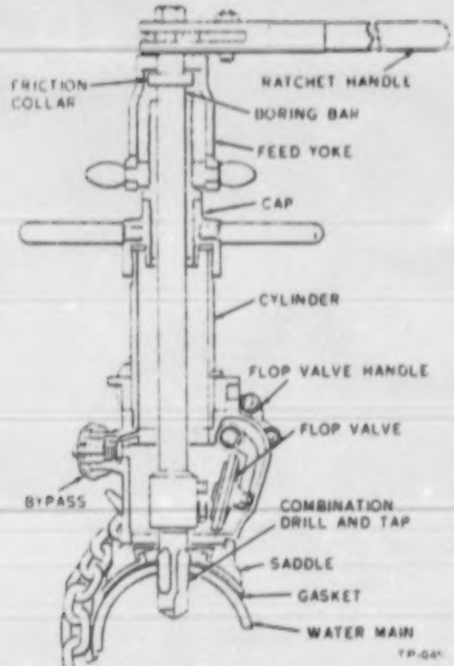

RATCHET HANDLE
FRICTION COLLAR
BORING BAR
FEED YOKE
CAP
CYLINDER
FLOP VALVE HANDLE
FLOP VALVE
BYPASS
COMBINATION DRILL AND TAP
SADDLE
GASKET
WATER MAIN
TP-041

Figure 28. Self-Tapping Machine

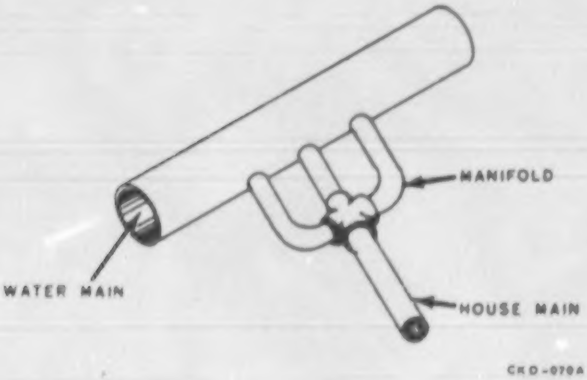

MANIFOLD
WATER MAIN
HOUSE MAIN
CKD-070A

Figure 29. Manifold Assembly

SERVICE MAIN LAYOUT

Plumbers Drawings

When plumbing blueprints are not available the plumber must prepare a working drawing of the system. Figure 30 illustrates some of the symbols used to identify not only piping but the liquid or gas that may be in the pipes.

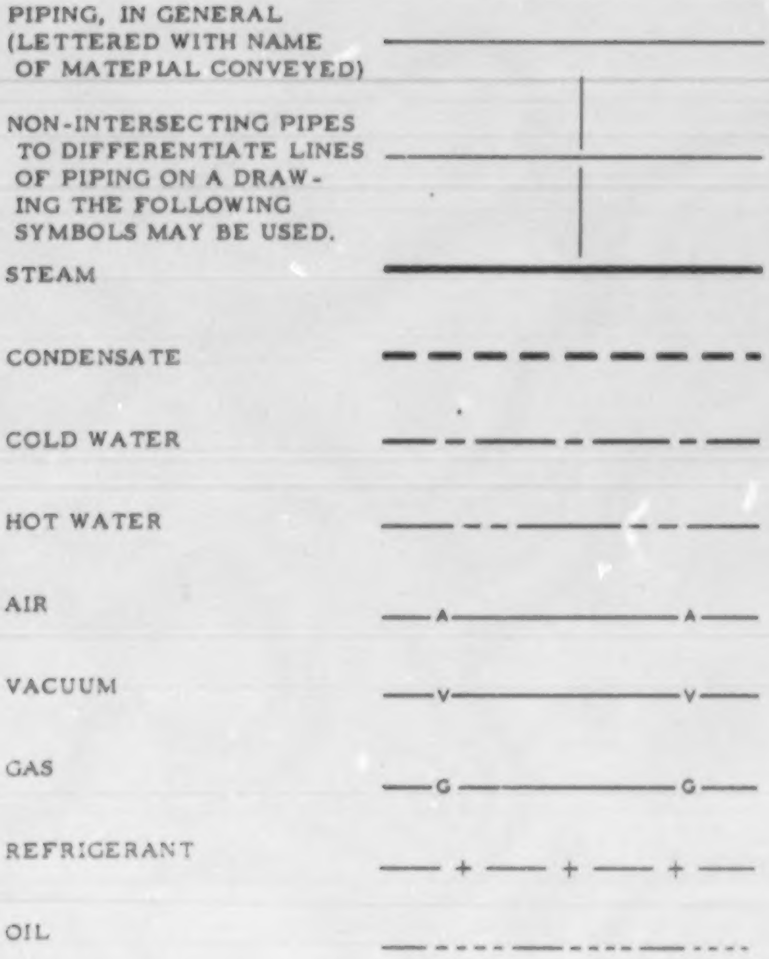

PIPING, IN GENERAL (LETTERED WITH NAME OF MATEPIAL CONVEYED)
NON-INTERSECTING PIPES
TO DIFFERENTIATE LINES OF PIPING ON A DRAWING THE FOLLOWING SYMBOLS MAY BE USED.
STEAM
CONDENSATE
COLD WATER
HOT WATER
AIR
A
A
VACUUM
V
V
GAS
G
G
REFRIGERANT
+
+
+
OIL

Figure 30. Plumber's Drawings

The location of other piping systems which may run parallel to, cross over, or even connect to the piping system being constructed must also be identified with the appropriate symbol (figure 31).

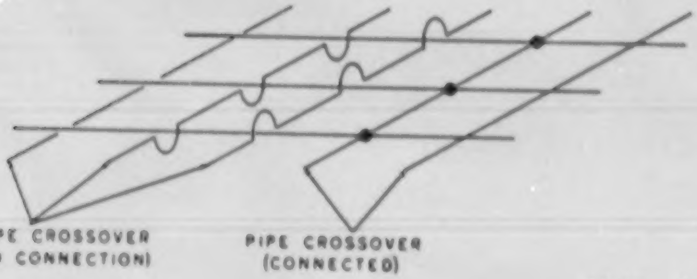


Figure 31. Pipe Crossover and Connection Symbols

Figure 32 illustrates a limited number of the symbols used to identify fittings and valves.

It is important for the plumber to not only use appropriate symbols but to be fairly accurate in his drawings. Such drawings often become part of the engineer drawings of the installation.

SUMMARY

In order to successfully plan and lay out a plumbing system, you must be able to read and interpret plumbing blueprints and drawings. A working drawing should be made, using information from the blueprints which show the locations of all fixtures, piping valves, and fittings. The drawing should contain only the applicable plumbing systems of the building and should be complete to the extent that it can be used to figure pipe lengths when figuring a bill of material for the job.

A water main can be tapped with a self-tapping machine if the pressure does not exceed 90 pounds or 200 pounds when using a "power clevis." If a service line of more than 1/4 of the size of the main is required, several holes are bored and combined into a special unit called a manifold. A corporation stop is used to screw into the water main so the service line can be run to the building.

A stop and waste valve is used in a supply line so the building water system can be drained to prevent freezing at times when it will be vacant.

QUESTIONS

1. Name the combination tool used to tap a water main.
2. Why must a service line be buried at a certain depth?
3. Name the types of pipes that may be used on a service line.

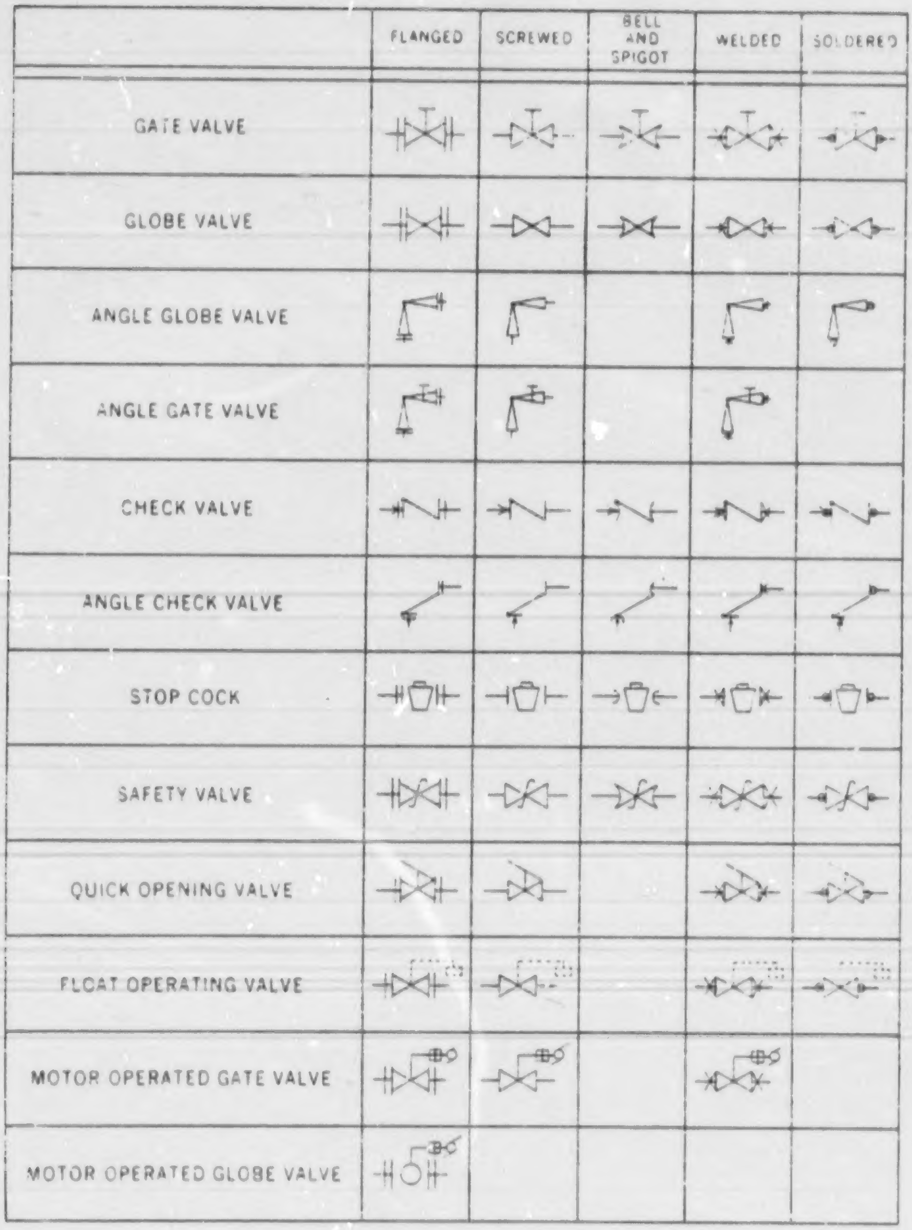

FLANGED
SCREWED
BELL AND SPIGOT
WELDED
SOLDERED
GATE VALVE
GLOBE VALVE
ANGLE GLOBE VALVE
ANGLE GATE VALVE
CHECK VALVE
ANGLE CHECK VALVE
STOP COCK
SAFETY VALVE
QUICK OPENING VALVE
FLOAT OPERATING VALVE
MOTOR OPERATED GATE VALVE
MOTOR OPERATED GLOBE VALVE

Figure 32. Symbols for Piping and Pipe Fittings

4. What is the purpose of a stop and waste valve?

5. What is the purpose of a curb stop?

6. Name two factors which affect the size of the building service line.

7. Name two types of flexible connections in conjunction with a building service line.

8. Name the valve that is installed in the water main with the self-tapping machine.

9. What is the maximum pressure of a water main in which a self-tapping machine may be used without attachments.

REFERENCES

1. AFM 85-20, Plumbing.

2. National Plumbing Code.

BUILDING DISTRIBUTION SYSTEMS

OBJECTIVE

The purpose of this study guide is to aid you in understanding the principles of the Building Distribution System and configuration of the system.

INTRODUCTION

The days of hauling water from the well to the house are gone due to the modern plumbing system. The neatness of installing the building distribution system will directly reflect the type of plumber who installed the system. A neat appearance of all plumbing work shows the pride a plumber takes in his work.

COMPONENTS OF BUILDING DISTRIBUTION SYSTEM

Main water distribution systems include all of the piping, fittings, and valves used to convey and control or throttle the water.

Building service mains include all pipes, fittings, and valves which convey water from the distribution mains to the building.

The building distribution system piping originates at the foundation of the structure and becomes an extension of the building service main. The pipe itself may enter the building through the basement walls or through the building foundation and into the crawl space under the floor joists.

Building Distribution Main

A shutoff valve is installed just outside of the foundation. Shutoff valves may also be located just inside the building where the piping enters through the basement wall. In either case, the piping extending from this point becomes the cold water distribution main, figure 33. Water is thus conveyed to various points throughout the building.

Branches

Areas requiring water supply within a building may not be in line with the cold water distribution main. Utility areas may be in one part of the building while sanitary facilities are in another. Branch lines, which may be short or long, are connected to the cold water distribution main and extend to the areas where the water is to be used, figure 33.

Branch lines may differ in size depending on the water demand of the area or fixture connected to them (figure 33). A reducer fitting is used when connecting a smaller branch line to the supply main.

In most installations the branch line is installed under the floor and between the floor joists. The branch line terminates at a point under floor and wall studs where a vertical piping section will be installed for fixture connection.

Branch lines normally run horizontally at a slight grade toward a shutoff valve. This facilitates easy drainage should it be required

Supports for the branch lines should be installed at no more than 10 foot intervals. Supports consist of either pipe straps, loops, or preformed hangers.

Permanent installations require that pipe support devices be of the same material as the pipe it supports. A form of corrosion called electrolysis occurs when dissimilar metals are in contact with each other. Corrosion would occur if a copper or brass pipe hanger is used to support a steel pipe. Corrosion would eventually cause either or both pipe and hanger to fail.

Supply Risers

Fixture supply risers are vertical piping that connect the branch line and fixture (figure 33). Risers should be supported at each floor level and joints. Pipe rests and clamps are used to provide support for vertical pipes and should not depend on horizontal fixture supply branches for support. All piping must be assembled and tested before the wall is finished.

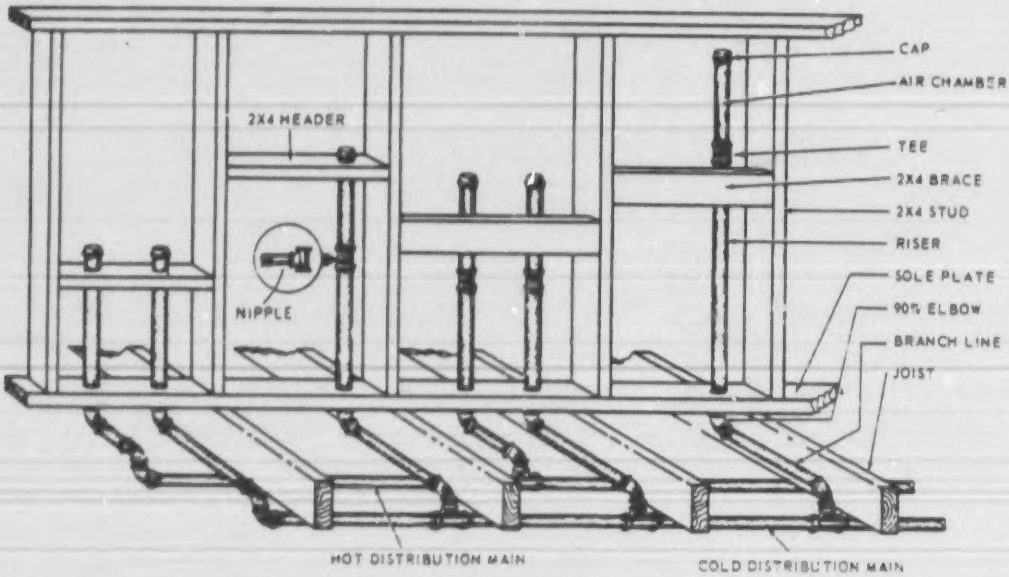

CAP
AIR CHAMBER
2X4 HEADER
TEE
2X4 BRACE
2X4 STUD
RISER
SOLE PLATE
NIPPLE
90% ELBOW
BRANCH LINE
JOIST
HOT DISTRIBUTION MAIN
COLD DISTRIBUTION MAIN

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Figure 33. Water Distribution Pipelines

The size of the pipe going to a fixture will depend on the type of the fixture. Listed below is a guide for normal pipe sizing.

Dishwasher	1/2" or 3/4"
Water Closet (Tank type)	1/2"
Water Closet (Flushometer)	1"

Urinal with Flushometer	3/4"	
Lavatory	1/2"	
Shower Bath	1/2"	
Kitchen Sink	1/2"	
Slop Sink	1/2"	
Scullery Sink	3/4"	
Laundry Tray	1/2"	
Drinking Fountain	1/2"	
Hot Water Heater (Domestic)	3/4"	supply
Bathtub	1/2"	

Air Chambers

Water hammer is a phenomenon that results from the sudden stoppage of waterflow in a pipe. The effect is the creation of a shockwave which travels back and forth between the faucets or valve and the point where the pipe changes direction.

Water hammer is more noticeable when it occurs in hard, rigid pipe such as iron, steel, or brass. It is less noticeable in flexible pipe such as copper.

Water hammer may be reduced by using any or all of the following methods: installing air chambers, as illustrated in figure 34, using slow closing valves and faucets or installing commercial type air chambers, sometimes referred to as shock absorbers.

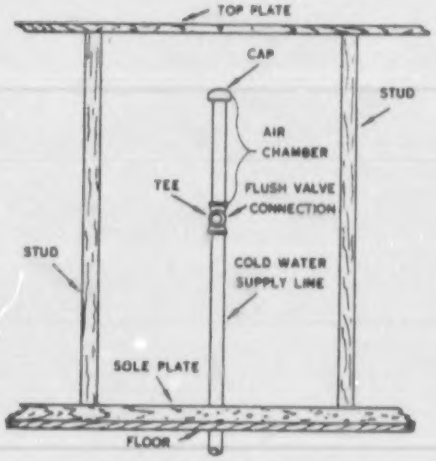


Figure 34. Air Chamber

TYPES OF PIPES AND JOINTS USED ON THE BUILDING DISTRIBUTION SYSTEM

Types of Pipes

The types of pipes most commonly used in hot and cold water systems are: galvanized, plastic, and copper.

Types of Joints

The types of joints most commonly used in hot and cold water systems are: threaded, soldered, solvent weld, and flared.

SUMMARY

The building distribution system consists of building distribution main, branches, risers, air chambers, valves, and fittings. Piping must be properly supported and slightly graded to facilitate drainage of the lines at the lowest point. The type of supports should be the same material as that of the pipe to prevent electrolysis. The types of pipes used consist of galvanized, plastic, and copper; joints consist of threaded, soldered, solvent weld, and flared.

QUESTIONS

1. What does the building distribution system consist of?
2. What is a branch?
3. What is a riser?
4. Why is the material used for hangers the same as the pipe?
5. How are supply risers supported?
6. What is the purpose of an air chamber?
7. Why do branches normally run at a slight grade?
8. On most installation where are branch lines installed?
9. How often should supply risers be supported?
10. How often should branch lines be supported?

REFERENCES

1. AFM 85-20, Plumbing.
2. National Plumbing Code.

COPPER TUBING ASSEMBLY

OBJECTIVE

The purpose of this study guide is to describe types of copper pipe and tubing and their assembly methods.

INTRODUCTION

Copper tubing and pipe have become increasingly popular with plumbers due to the ease with which they can be assembled and installed.

Copper pipe or tubing preparation and assembly methods will be discussed under the following headings:

- IDENTIFICATION OF COPPER PIPE AND TUBING
- CUTTING AND BENDING METHODS
- FLARED AND SOLDERED COPPER JOINTS
- TORCHES

IDENTIFICATION OF COPPER TUBING

There are four main types of copper tubing. They are K, L, M, and DWV. The classification is determined by wall thickness.

Type K

A green color band and/or a stencil on the tubing surface identifies the pipe as type K. It is recommended for underground installation and high pressure. Type K is available in a variety of sizes ranging from 1/4" to 12" in diameter and has the thickest wall of the four types.

Type L

A blue color band and/or a stencil identifies this copper tubing. It has a medium wall thickness and is recommended for interior use. Type L is also available in 1/4" to 12" diameters.

Type M

Type M has a light wall thickness and is used in low-pressure installations. It is color coded red. Type M is available in sizes 1 1/4" through 6" in diameter.

Type DWV

The thinnest wall of all types of copper tubing is classified as DWV. It is used in nonpressure applications and is distinguished by a yellow band. This material is available in sizes 1/4" to 6" in diameter.

Copper tubing may be obtained either in hard drawn (hard temper) or annealed (soft temper).

The hard drawn copper (K, M, DWV) is available in 20-foot lengths. Annealed copper, including K and L are available in rolls.

CUTTING AND BENDING METHODS

Cutting Methods

A watertight joint begins with correct joint preparation.

The initial step in preparing a joint is to measure the pipe and mark it. It is a simple enough operation. To get the measurement for the pipe length, however, involves consideration for fittings and type of connection. This subject will be discussed later in the study guide.

Once the tubing is measured and marked it must be cut. The desired tool for cutting copper is the tube cutter (figure 35). Its operation is no different than the pipe cutters used in earlier lessons. Copper tubing is softer than iron or steel. Caution should be exercised when tightening the cutting wheel against the tubing. The tubing may flatten under pressure.

A fine-toothed hacksaw may be used to cut copper tubing. A proper jig for supporting the tubing while cutting is recommended (figure 36). A fine-toothed blade (32 teeth per inch) will make a clean cut and the tendency for the copper to tear is minimized. Too much pressure applied to this hacksaw on the forward stroke will not only tear the copper but also tends to flatten the tubing.

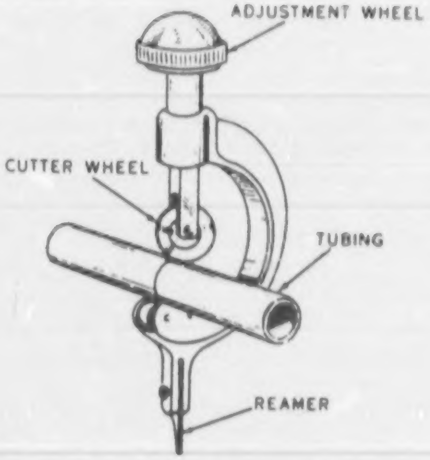


Figure 35. Tube Cutter

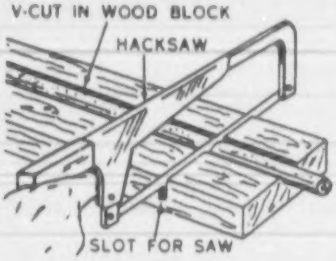


Figure 36. Jig for Cutting Tubing

Bending Methods

Either hard or soft drawn copper tubing may be used for waterlines. Soft copper can be formed into desired bends to change line direction. If care is taken, copper tubing may be bent by hand. However, the slightest excess pressure at one point will result in a flattened or kinked tube.

When hard copper tubing is used, a fitting should be used for changing directions. However, hard tubing requires annealing (softening) the portion to be bent. A torch is used to heat the pipe to a dull red glow. Applying a cold wet rag to the area will aid the annealing process and cool the metal quickly.

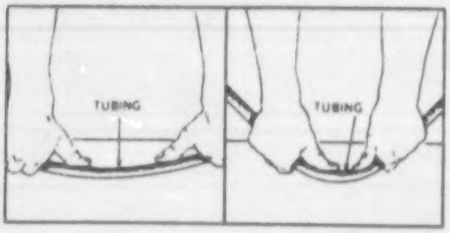


Figure 37. Bending Tubing Filled with Sand

Kinking may often be prevented when bending tubing by hand by filling the tube with sand. Figure 37 illustrates bending a sand-filled tube by hand.

A bending spring, shown in figure 38, may also be used to prevent the tubing from flattening or kinking. The spring is available in a variety of sizes, and can be used on the outside or inside of the tube.

Mechanical tubing benders are considered the most practical method of bending soft copper tubing. Figure 39 illustrates a typical mechanical tube bender. Benders are available in a variety of sizes and designs.

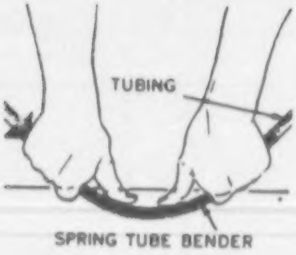


Figure 38. Bending Tubing Using a Spring

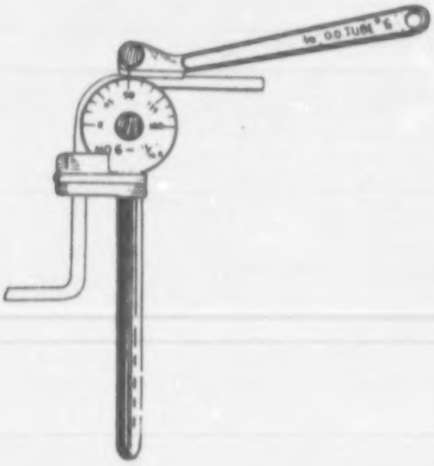
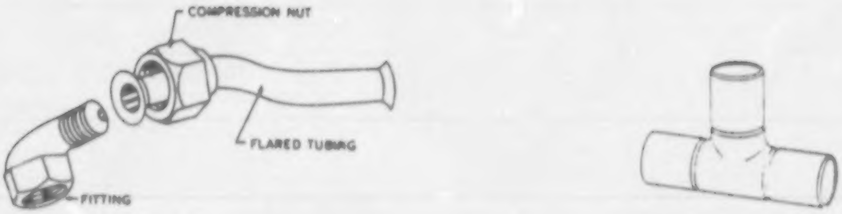


Figure 39. Tube Bending Tool

FLARED AND SOLDERED COPPER JOINTS

Bending tubing is not always used to change pipe direction. Fittings, either flared or soldered may be used. Figure 40 illustrates fittings requiring both flared connections and soldered connections. Copper tubing will never be threaded, as the walls are too thin.



Flared Joint

Soldered Joint

Figure 40

An easy and satisfactory method of joining copper tubing is done by flaring the ends of the tubing and pressing the flared end against the tapered surface of the fitting and then screwing the flare nut up tight over the end of the fitting (see figure 41).

One advantage of flared connections over soldered connections is the flared can be disassembled without problems.

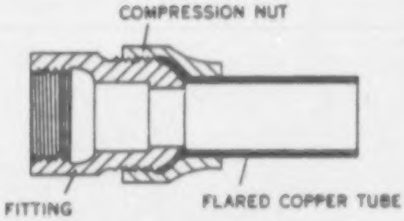


Figure 41. Cross Section of Flared Fitting

The total length of the tubing will be reduced somewhat due to the flare. Allow 1/8 inch for flare loss. After the tubing has been cut it will be necessary to dress both the inner and outer surfaces. Insert a reamer into the tubing and turn clockwise until the tubing is returned to its original diameter and burrs have been removed. Remove burrs from the outer surface with a fine tooth rattail file or emery cloth (figure 42).

51- 75-802

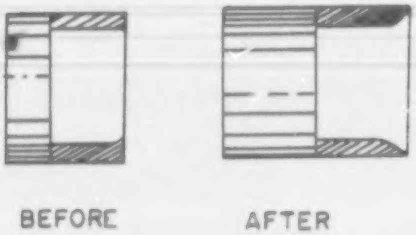


Figure 42. Before and After Reaming Copper Tubing

Flaring copper tubing requires the use of a flaring block and cone (figure 43) or a flaring plug (figure 44). Each is available in various sizes.

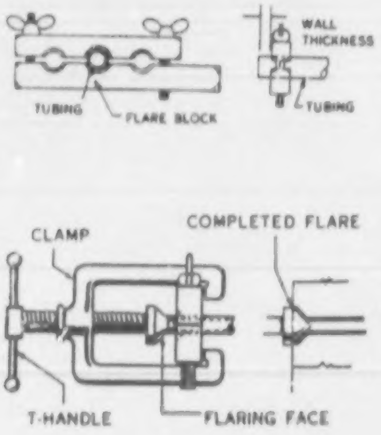


Figure 43. Flaring Tools

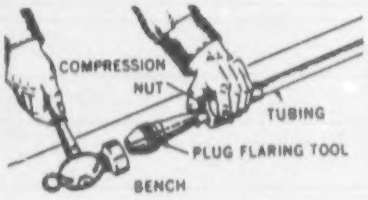


Figure 44. Flaring Plug

The flaring plug may be used in conjunction with a flaring block or may be used alone. The stem is inserted into the pipe or tubing. The pipe or tubing must be firmly held while the plug is driven into the pipe. Blows applied to the plug should be moderate. This permits the flare to form and prevents it from splitting.

A flaring block is used to hold the tube firmly when using a flare cone or plug. The tube is inserted into the correct size hole and the block is tightened. The tube should extend above the block a wall thickness of the tube. The cone is aligned and screwed into the tube. Again take care not to tighten the cone when the flare is completed, splitting the flare may result.

SOLDERING COPPER TUBING

Copper tubing is joined to fittings by flaring the ends and using special fittings or by soldering the tubing to a fitting. Soldered connections are normally used because they are easier to make and will withstand vibration better.

To prepare copper tubing for a good joint follow this process. After the tubing has been measured, cut, and reamed, the outside of the tubing and inside of the fitting should be cleaned and fluxed. The flux prevents oxidation. Heat is then applied evenly around the fittings. Moving the flame back and forth will prevent overheating.

When a line of solder (50-50) shows up around the fitting, that is, a bead of solder appears at the edge of the fitting, the joint has all the solder it will take. The process of the solder being drawn around the joint is called capillary attraction.

The joint should be allowed to cool for a short while. A rag, saturated with water, will hasten the cooling. Remove any surplus solder with a wet rag by wiping the joint quickly while it is still hot.

When disconnecting a soldered copper tube from a fitting on which other soldered connections are to be left intact, the application of a wet cloth to the parts which are not to be disconnected will prevent melting of the solder at such connections. This application of a wet cloth on joints already soldered will aid in the soldering of a joint nearby. If two outlets of a "tee" are wrapped with a wet cloth, the other outlet of the "tee" can be soldered and not melt the other two outlets. Figure 45 shows how to apply wet rag when soldering.

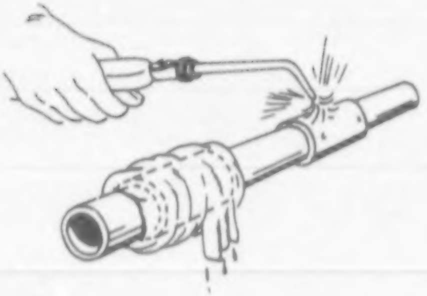


Figure 45

There are numerous hazards which will be involved during sweat soldering copper tubing. The fittings and pipe will be extremely hot and must not be laid where someone else could pick them up accidentally. Gloves and goggles should be worn during the operation for protection of the hands and eyes.

When soldering around combustible materials, care must be taken as to where the flame is pointing. It would be very easy to start a fire with the acetylene torch by just touching a structural member with the flame.

TORCHES

The heat necessary for "sweating" fittings on copper pipes should be a concentrated flame of high enough temperatures to quickly bring the fitting to the melting point of solder. 50-50 solder (50 percent lead and 50 percent tin) melts at 360 degrees F, and is free flowing at 415 degrees F. Silver solder, used for high-pressure lines, has a much higher melting point, and is free flowing at over 1,000 degrees F. A blowtorch is capable of producing enough heat to melt and free flow 50-50 solder, but the flame isn't concentrated and the torch is cumbersome to use. If at all possible, an air-acetylene torch should be used (figure 46).

Small portable cylinders of acetylene gas with hose and tip connections produce very efficient heat for soldering.

The acetylene gas mixes with the atmospheric air containing 21 percent oxygen to support combustion

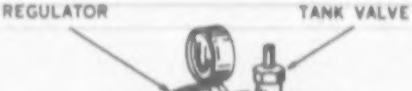


Figure 46. An Air-Acetylene Torch

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and produces a flame up to 4,000 degrees F. Figure 45 shows an air-acetylene unit.

Oxyacetylene welding systems may be used if care is exercised when operating it. The high purity oxygen combined with acetylene produces a very high heat and could burn fittings and tubing if allowed to remain in one spot for too long a time. An oxyacetylene unit is shown in figure 47.

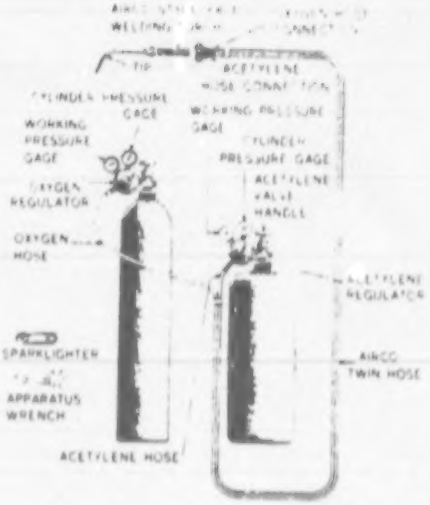

TIP
ACETYLENE HOSE CONNECTION
CYLINDER PRESSURE GAGE
WORKING PRESSURE GAGE
WORKING PRESSURE GAGE
CYLINDER PRESSURE GAGE
OXYGEN REGULATOR
ACETYLENE VALVE HANDLE
OXYGEN HOSE
ACETYLENE REGULATOR
SPARKLIGHTER
AIRCO TWIN HOSE
APPARATUS WRENCH
ACETYLENE HOSE

Figure 47. An Oxyacetylene Unit

Compression Fitting

Compression fittings (see figure 48) are used to connect copper tubing. These fittings consist of three parts; the fitting, a compression ring, and a nut. After the tubing has been cut, reamed, and dressed, slip the nut on the tubing first and then the compression ring. Use an open-end wrench or an adjustable jaw and tighten the nut on the fitting. The nut will squeeze the compression ring between the fitting and the nut making a water- and gastight seal.

Figure 48. Compression Fittings

357

SUMMARY

Some advantages of copper tubing are: less weight, handles easier, resists corrosion, has smooth interior, requires less space, easier to fabricate, and easier to cut and bend.

There are four types of copper tubing: K, L, M, and DWV. If tubing is to be bent, several methods can be used; the mechanical bender is the best. Fittings are also used to change pipe direction. Joints are made by either flare or soldered connections. In either case, allowances have to be made for the flare and fitting length in determining pipe length. Pipe ends must be reamed and dressed after cutting if a good joint is to be made.

Copper pipe and tubing may be cut by either tube cutter or hacksaw. Tube may be flattened if too much pressure is applied to the cutting wheel. A hacksaw blade of 32 teeth per inch is recommended when cutting copper tubing. Excessive pressure on the blade may not only flatten the tube but tear the copper as well.

A variety of torches may be used for heating copper joints for sweat soldering. The air-acetylene torch is the most desirable.

QUESTIONS

1. Why is copper tubing flared or soldered rather than threaded?
2. What methods are used to change pipeline direction?
3. What must be done to tubing before attempting to flare?
4. When is it necessary to anneal copper tubing?
5. What are the classifications of copper tubing?
6. What is the purpose of flux?
7. What draws solder into the space between the tubing and fitting?
8. What is required to insure a good soldered connection?
9. What is used to hold the flared end of the pipe to the fitting?
10. How far above the surface of the block should the tube extend to make a good flare?

REFERENCES

1. AFM 85-20, Plumbing.

2. AFM 127-101, Industrial Safety Accident Prevention Handbook.

WATER SUPPLY ROUGH-IN FOR FIXTURES

OBJECTIVE

This study guide will help you to better understand the proper procedures for roughing-in the supply risers to fixtures.

INTRODUCTION

Providing water supply to the fixtures is the final step prior to installing the fixtures. The fixtures cannot operate in a sanitary manner without a water and waste system. Piping for these fixtures must be installed according to the manufacturer's specifications.

BUILDING WATER DISTRIBUTION SYSTEM

The building water distribution system is all the piping inside the building. The distribution system conveys water from the service main to the plumbing fixtures and other water outlets. The components of the building distribution system are the distribution main, all branches, risers or drops, and control valves.

Distribution Main

A distribution main is the horizontal pipe inside the building that connects to the service main and extends full length under the building.

Branch

The branch is the horizontal pipe that connects to the distribution main and is run to an area close to the fixture.

Riser

A riser is a water supply pipe which extends vertically to convey water to the fixture.

Types of Piping

The types of pipes most commonly used in a water distribution system are galvanized, plastic, and copper.

Air Chambers

Water hammer is a phenomenon that results from the sudden stoppage of waterflow in a pipe. The effect is the creation of a shockwave which travels back and forth between the faucets or valve and the point where the pipe changes direction.

Water hammer is more noticeable when it occurs in hard, rigid pipe such as iron, steel, or brass. It is less noticeable in flexible pipe such as copper.

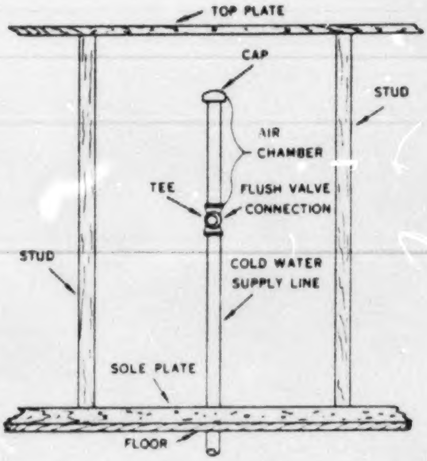


Figure 49. Air Chamber

This phenomenon may be reduced by using any or all of the following methods: installing air chambers, as illustrated in figure 49, using slow closing valves and faucets or installing commercial type air chambers, sometimes referred to as shock absorbers.

Backing Boards

Before any wall-hung fixture is installed, a backing board or mounting board must be installed in the building wall to support the fixture (see figure 50). The board is usually constructed of a 2-inch by 4-inch or 2 X 6 timber and is notched into the studding of the building at an appropriate height for hanging the fixture. The studs should be notched evenly and the bottom of the mounting board should bear directly on the notched portion of each of the studs.

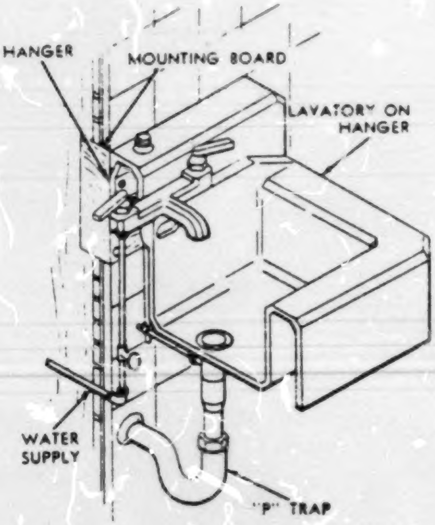


Figure 50. Backing Board Installation

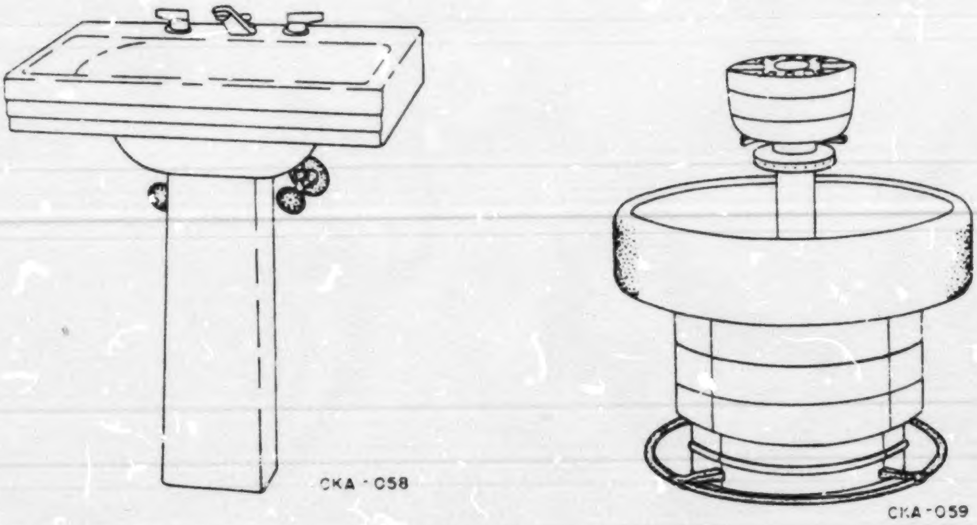
Lavatories

A lavatory is an essential fixture for all Air Force bases. If it is installed properly, it will probably be maintenance-free for many years.

Figure 51 illustrates the most popular types used in the Air Force. They are: wall hung, pedestal, counter top (flat rim), and trough.

A. Wall Hung Lavatory

C. Counter Top Lavatory



B. Pedestal Lavatory

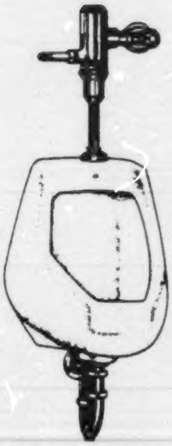
D. Trough

Figure 51. Lavatories

Urinals

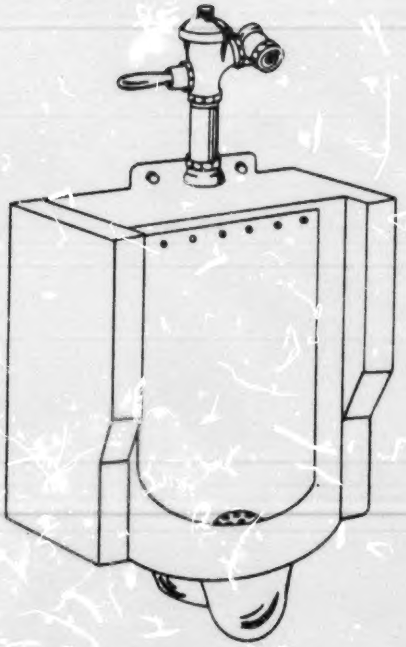
There are four basic types of urinals, see illustrations 52A. B, C, D, and E. They are the wall hung, trough, pedestal, and stall types. The stall type is used extensively in public buildings. The wall hung and the pedestal types are common in the military usage.

The trough and stall types of urinals are not approved for use in new construction or maintenance replacement in the Air Force. Urinals are made of porcelain, enameled cast iron, or vitreous china because they must have a high resistance to acids.



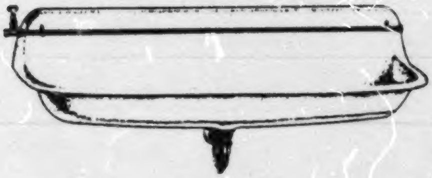
Wall Hung Urinal

A



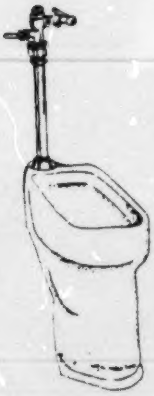
Wall Hung Urinal

B



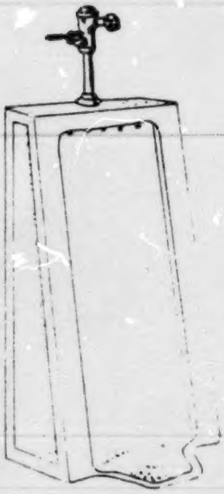
Trough Urinal

C



Pedestal Urinal

D



Stall Urinal

E

Figure 52. Urinals

6B-75-802

Water Closets

Water closets (figure 53) for plumbing fixtures are used to convey organic body wastes to the drainage system. The closets are constructed so that flushing will siphon out the contents. The flushing action also siphons the water out of the trap seal. The trap is resealed by the refill provided in the closet tank.

Water closets made of vitreous china are available in a wide variety of types, including the common washdown bowl, the washdown bowl with jet, the reverse trap bowl, and the siphon jet bowl. Although each of these water closet types is installed in the same way, they differ in their flushing action.

Figures 53 illustrate the wall-hung type and the floor-mounted type.

Wall-Hung Water Closet

A

Floor-Mounted Water Closet

B

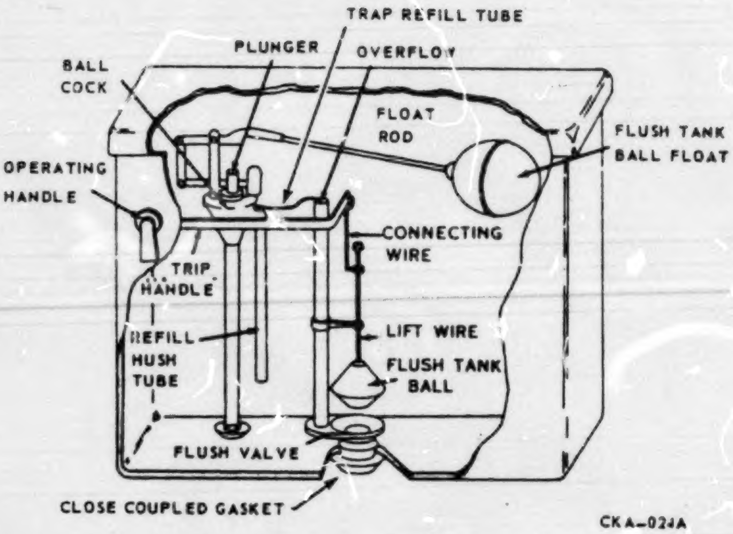
Figure 53. Water Closets

Flushing Mechanism

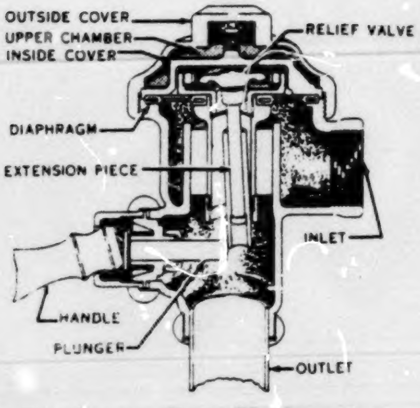
Cold water for flushing a water closet can be supplied to a water closet by a closet tank or a flushometer type flush valve. The closet tank is used mostly in residential water closets. With such a tank, a minimum of water is effective in quietly and efficiently flushing the water closet.

Flushometer type flush valves are more advantageous in installations where noise and economy are not particularly important. The required size waterline for a water closet equipped with a flushometer is 1 inch and for a water closet equipped with a tank 1/2 inch.

Figure 54 illustrates the two types of flushing mechanisms.


TRAP REFILL TUBE
PLUNGER
OVERFLOW
BALL COCK
FLOAT ROD
FLUSH TANK BALL FLOAT
OPERATING HANDLE
CONNECTING WIRE
TRIP HANDLE
REFILL HUSH TUBE
LIFT WIRE
FLUSH TANK BALL
FLUSH VALVE
CLOSE COUPLED GASKET
CKA-024A

Flush Tank
A


OUTSIDE COVER
UPPER CHAMBER
INSIDE COVER
RELIEF VALVE
DIAPHRAGM
EXTENSION PIECE
INLET
HANDLE
PLUNGER
OUTLET

Diaphragm Type Flushometer
Valve
B

Figure 54. Flushing Mechanism.

6F- 75-802

Symbols for Fixtures

Plumbing like other trades, has a language of its own. It is not only spoken and written, but also pictured by the use of symbols on blueprints and drawings.

Figure 55 illustrates a few of the symbols of fixtures commonly used in the Air Force.

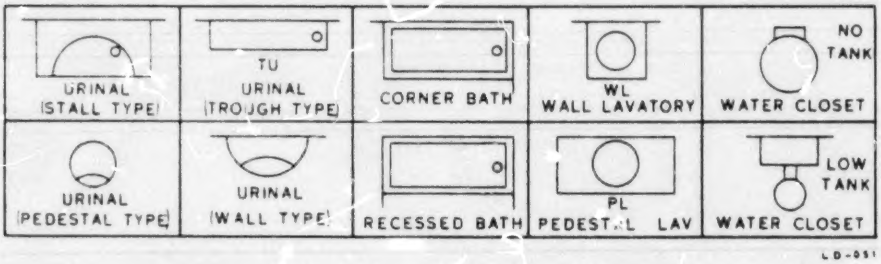

URINAL
(STALL TYPE)
TU
URINAL
(TROUGH TYPE)
CORNER BATH
WL
WALL LAVATORY
NO TANK
WATER CLOSET
URINAL
(PEDESTAL TYPE)
URINAL
(WALL TYPE)
RECESSED BATH
PL
PEDESTAL LAV
LOW TANK
WATER CLOSET
LD-051

Figure 55. Symbols of Plumbing Fixtures

Rough-In Procedures

The building water distribution system of a building consists of all the piping, fittings, and valves that carry water from the service as well as to the building plumbing fixtures and equipment.

BATHTUB-SHOWER COMBINATION

Today's health standards require that some type of bathing facility be available in every dormitory and private home or dwelling. A bathtub-shower combination is designed to be installed in a home. It gives the user an option between taking a shower or relaxing in a tub full of water. The plumber must know beforehand that a combination bathtub-shower will be installed. It would not make any difference as far as the drainage is concerned. Adding the shower would make a difference in roughing-in the water system however.

There are many types of bathtubs in use today. Each manufacturer makes their own design. However, they have a few design features in common. Such as, they are either right- or left-handed (see figure 56), recess or corner, and are made of steel or cast iron with a baked enameled finish. When a shower is added then the bathtub becomes the shower base.

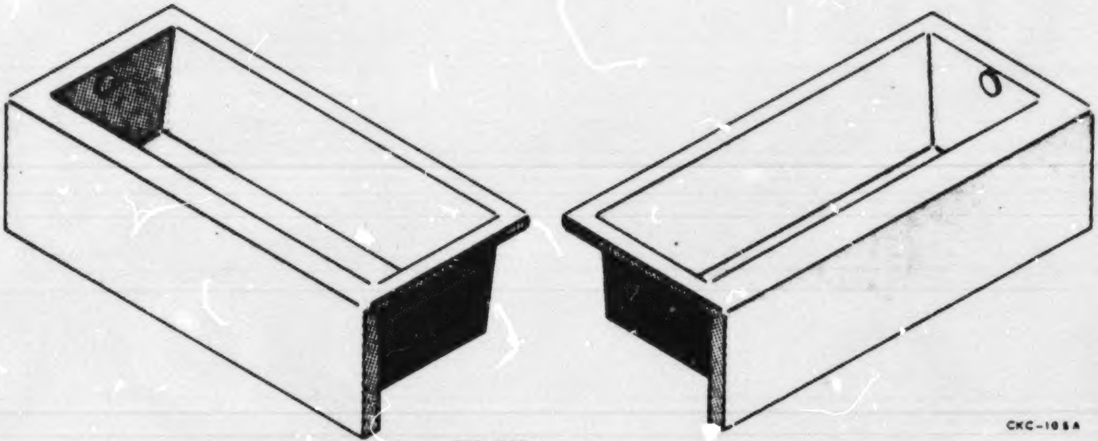


Figure 56. Left- and Right-Hand Tub

SHOWERS

Showers are designed for use in dormitories, hospitals, and industrial areas. Many homes have showers known as a three-quarter bath. They are usually located off the master bedroom.

Individual Shower

This type of shower, figure 57, can be found in either a home or a dormitory. It could be a stall type or it could be all tiled with either a shower curtain or enclosed with a glass or plastic door.

Showers in a dormitory could be exactly the same as in a home except that there would be more than one shower.

Gang Type Shower

This type of shower is used by industry, gyms, dormitories, and institutions, see figure 58. It is used where many people bathe at one time. Usually it is a room with waterproofed walls and a large floor drain or drains, therefore, a gang type shower would be any shower room with two or more shower heads.

Figure 57. Individual Shower

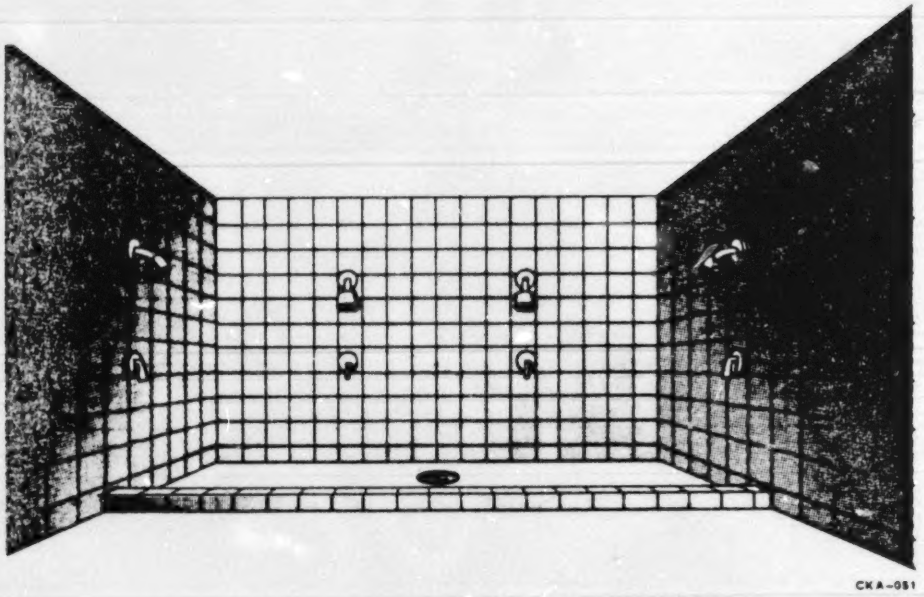


Figure 58. Gang-Type Shower

SHOWER ROUGH-IN PROCEDURES

Knowing the proper steps to take is very important in installing the piping system for a fixture. Even an experienced plumber should not rely on past experience, but should refer to specifications when installing the piping system for a fixture.

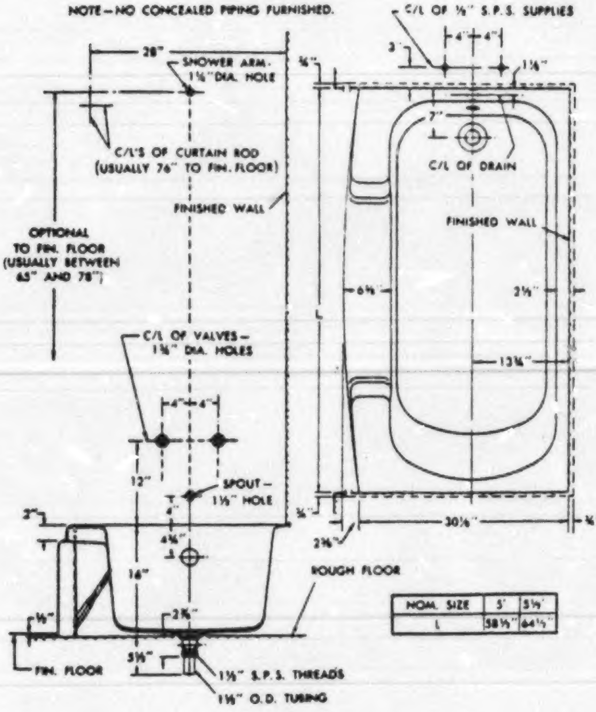
Specifications

Before roughing-in water supplies to a fixture, know the type of fixture to be installed. The type of fixture to be installed is identified on the blueprint for the particular job. Refer to the manufacturer's rough-in specification for the rough-in piping measurements.

Figure 59 is an example of a manufacturer's rough-in specification for a bathtub and shower combination. The rough-in sheet gives two views and the necessary measurements for correct location and installation of rough-in piping for the fixture. By referring to the drawing the plumber can determine that the water supply risers must be 8" apart to correctly connect the mixing faucet to the pipes. Measurements are important to the plumber when roughing-in piping.

The knowledge gained in preceding lessons can be used when measuring, cutting, reaming, threading, and installing pipe and fittings for the bath and shower water supply. In most installations, the branch line is run under the floor and between the floor joists to the point under the wall where the holes are cut through the floor and soleplate to permit the piping to go to the fixtures. The pipe risers then extend up through the holes to the height necessary to connect with the fixtures. When it is necessary to run the piping down from an overhead distribution system the piping is called a drop, rather than a riser.

Enameled Recess Bath Combinations


NOTE—NO CONCEALED PIPING FURNISHED.
28"
SHOWER ARM. 1½" DIA. HOLE
C/L'S OF CURTAIN ROD (USUALLY 76" TO FIN. FLOOR)
FINISHED WALL
OPTIONAL TO FIN. FLOOR (USUALLY BETWEEN 65" AND 78")
C/L OF VALVES—1⅜" DIA. HOLES
4"
4"
12"
SPOUT—1½" HOLE
4"
2"
4⅜"
16"
2⅞"
½"
5½"
FIN. FLOOR
1½" S.P.S. THREADS
1½" O.D. TUBING
ROUGH FLOOR
C/L OF ½" S.P.S. SUPPLIES
4"
4"
3"
1⅛"
¾"
7"
C/L OF DRAIN
FINISHED WALL
L
6⅛"
2½"
13¾"
¾"
30⅛"
¾"
2⅜"

NOM. SIZE	5'	5½'
L	58½"	64½"

CKA-062

Figure 59

The branches are connected to the main line by using a nipple and a 90 degree elbow. (See figure 60.)

In fixtures with hot and cold water, the hot water should always be on the left.

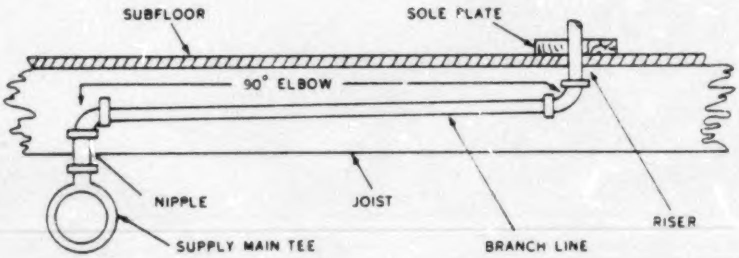

SUBFLOOR
SOLE PLATE
90° ELBOW
NIPPLE
JOIST
RISER
SUPPLY MAIN TEE
BRANCH LINE

Figure 60. Branch Line

The hot and cold water branches normally run at a slight grade, dropping toward the meter or shutoff valve. This allows the system to be drained.

The branch and main lines should be supported at 10-foot intervals or closer to prevent sag and to maintain proper slope or grade. Supports may be of pipe strap, pipe hangers, wire loops, or manufacturered preformed hangers. On permanent installations, the supports should be of the same material as the pipe to prevent "electrolysis" which destroys metal by the action of an electrical current that develops between dissimilar metals.

The hot and cold water supply risers are connected to the branch lines by means of a 90 degree elbow and extended above the finished floor to the heights given for that particular fixture indicated in the manufacturer's rough-in specifications. The risers should be supported by using a 2" X 4" header cut to fit tightly between the studs. The header has two holes, 8" apart, bored through it and large enough to allow the pipe to pass through freely. The header will support the risers and keep them aligned to receive the combination faucets, see figure 61.

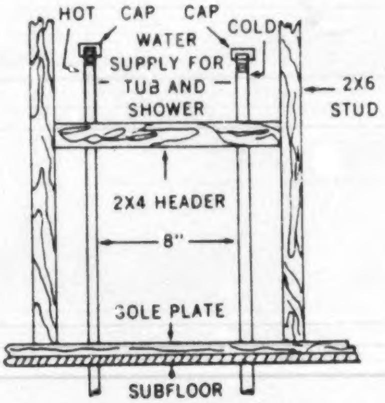

HOT
CAP
CAP
COLD
WATER SUPPLY FOR TUB AND SHOWER
2X6 STUD
2X4 HEADER
8"
SOLE PLATE
SUBFLOOR

Figure 61. Fixture Risers and Header Support

Mixing Valve

Mixing valves (figure 62) for bathtubs, showers, or combination tub and shower installations are nothing more than two valves (one for hot

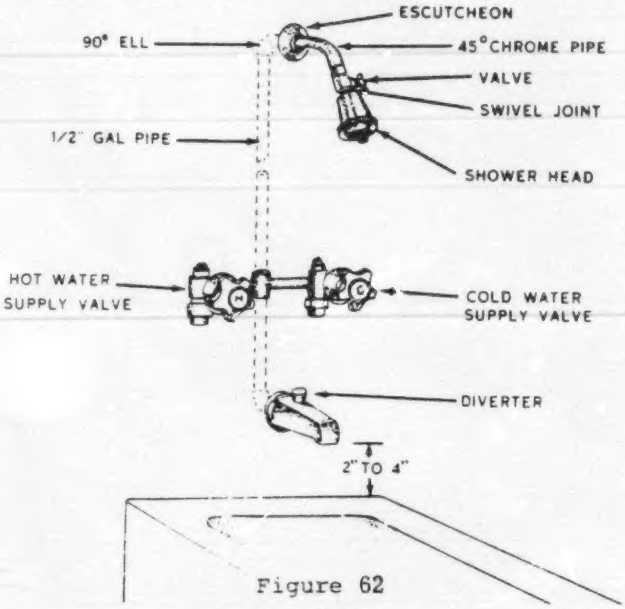

ESCUTCHEON
90° ELL
45°CHROME PIPE
VALVE
SWIVEL JOINT
1/2" GAL PIPE
SHOWER HEAD
HOT WATER SUPPLY VALVE
COLD WATER SUPPLY VALVE
DIVERTER
2" TO 4"

Figure 62

water and another for cold water) in one body. These valves can have two separate handles or only one, which can be regulated to adjust the temperature of the water before it leaves the tub spout or shower head. Installation of the mixing valve, riser for the shower head, and the drop for the tub spout is accomplished as part of the rough-in. The trim (chrome pipe, shower head, spout, and valve handles) is not installed until the finished wall or wall tile has been put up by the carpenters. A bathtub is considered as a rough-in item and must be installed before the finished walls can be put up.

SUMMARY

Each plumbing fixture must be furnished with water at a rate of flow which will fill or supply it to capacity within a reasonable time. Manufacturers of plumbing fixtures furnish roughing-in specifications to the plumbing contractor when he purchases fixtures. An experienced plumber accustomed to installing certain fixtures may not need to refer to rough-in specifications before installing piping and fixtures. Many shops furnish their plumbers with simple working drawings which are made from the manufacturer's rough-in specifications. The roughing-in specifications will indicate the manufacturer's name, the type of fixture according to model numbers, the type of operation, the type of flushing mechanism, and the measurements for installing piping and the fixture.

All horizontal runs of the fixture supply risers should be graded toward the main distribution line, because this will drain all water out of the line and will prevent freezing after the water is cut off. Shock absorbers or air chambers should be installed to eliminate water hammer.

QUESTIONS

1. What is the purpose of the manufacturer's rough-in specifications?
2. What types of urinals are approved for new work on Air Force installations?
3. Name four types of lavatories.
4. What information can the plumber get from the manufacturer's rough-in specifications?
5. What kind of piping may be used when fabricating the building water distribution system?
6. What is the function of backing boards.
7. What causes water hammer?
8. What is a riser?
9. What determines the height of a riser?
10. What is the purpose of a header?
11. Define a branch line.
12. How many shower heads would you find in a gang-type shower?
13. Name two flushing mechanisms that can be used to flush a water closet?

7B-75-802

INSTALLATION OF DOMESTIC WATER HEATER

OBJECTIVE

The purpose of this study guide is to acquaint you with the electric and gas fired domestic water heaters.

INTRODUCTION

The hot water system is that portion of the plumbing installation that supplies hot water to the fixtures.

There was a time when hot water delivered to plumbing fixtures was a luxury, and very few people, even those that were considered well to do, were provided with this convenience. Sanitation standards of today, however, require installation of some type of hot water system, so that even the humblest dwelling is provided with this convenience.

Hot water systems that are not properly installed will cause the plumber many maintenance problems.

TYPES OF DOMESTIC HOT WATER HEATERS

Domestic hot water heaters are grouped into two categories: electrically heated and gas fired. Both types have advantages and disadvantages over the other. The life expectancy of a hot water heater is materially shorter today than it was five or ten years ago for three good reasons.

1. Automatic dishwashers and clothes washers are widely used and they demand high temperature water.

2. People have increased the amount of hot water they use for all purposes.

3. The widespread use of copper supply lines has expanded galvanic corrosion. This may be prevented by the use of dielectric unions, or plastic types of fittings between the dissimilar metals.

Great progress has been made in manufacturing automatic hot water heaters. Manufacturers have developed an excellent heater, both electric and gas, which is fully automatic. They are compact units and are manufactured in different shapes and sizes with a tank capacity of 20, 30, or 40 gallons. These water heaters have many features that will keep them operating for a long period of time with a minimum amount of maintenance.

Gas Fired Hot Water Heaters

Gas fired water heaters (see figure 63) are designed with all controls immediately accessible for adjusting or service. They have a fast recovery time. That is to say, as hot water is used, it will take less time to heat more water in a gas fired heater than in an electric heater.

1. Outside casing of sheet steel. Galvanized inside and out. Beautiful, lustrous baked enamel finish makes cleaning an easy task.

2. Heatseal insulation, packed by special process forms a complete covering of thousands of tiny inert air spaces around all sides, top, and combustion chamber.

3. Cold water drop tube. Loose and removable. Extends to within a few inches of bottom of tank keeping cold water from mixing with the hot.

4. Heat deflector is located in flue way. It baffles the burned gases and utilizes the flue, which is completely surrounded by water as additional heating surface.

5. All-metal instant action temperature control. Substantially constructed, dependable, and accurate. There are only two positions of operation - the burner is full ON or completely OFF with only a tiny pilot burning.

6. Temperature control dial. With arrow indicator. Can be set to maintain any temperature from 80° to 180°F.

7. Safety gas control is always on duty to shut off main burner gas supply if the pilot should be extinguished. Air control to the burner is the only adjustment of the burner flame.

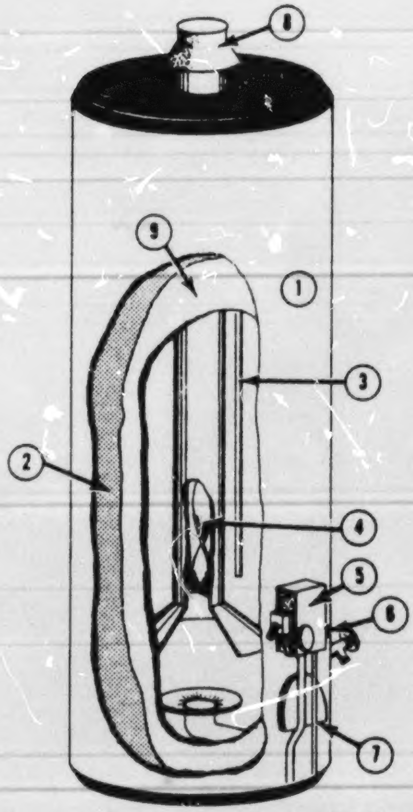


Figure 63. Typical Construction of a Gas Water Heater

8. The draft hood is designed to prevent downdrafts and consequent troubles. It also eliminates excessive cooling drafts through the heater flue.

9. Service. The tank is heavy galvanized steel. Tested at 300 lbs; working pressure 127 1/2 lbs.

10. Drain cock with hose connection to flush any accumulation of sediment from the heater. Hot water may be used for cooking or drinking. Water heaters furnish hot water as pure as your cold water.

Electric Hot Water Heater

Figure 64 illustrates a cutaway of a typical electric hot water heater. Some of the features of this type of heater are:

1. A flue is not required, therefore, the heater can be installed in any manner in the home.

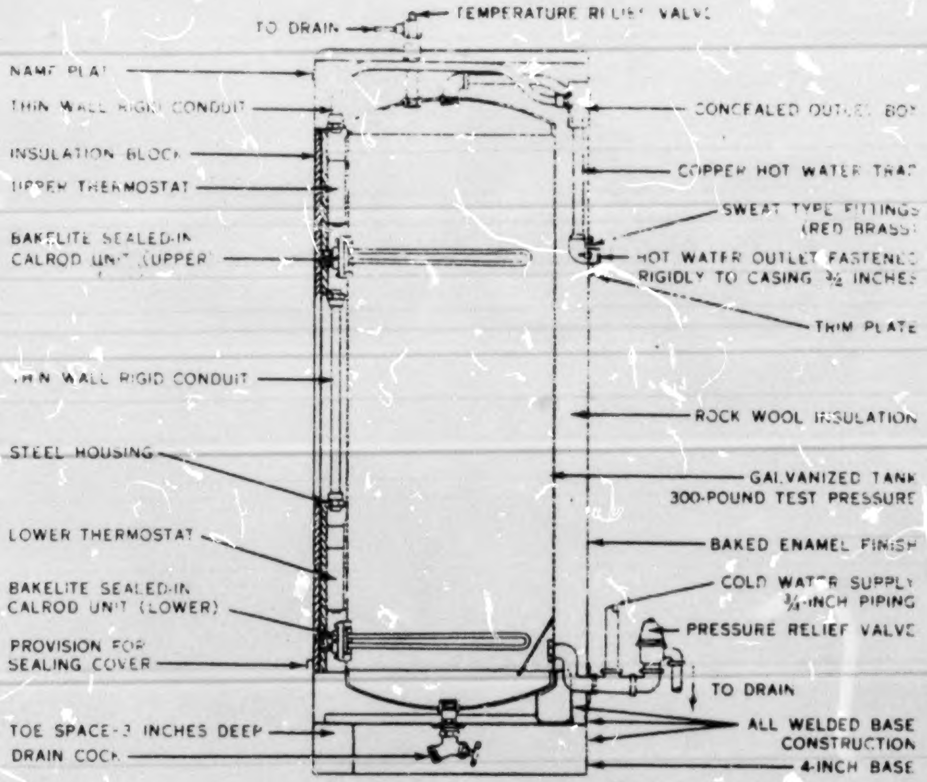

TO DRAIN
TEMPERATURE RELIEF VALVE
NAME PLATE
THIN WALL RIGID CONDUIT
CONCEALED OUTLET BOX
INSULATION BLOCK
UPPER THERMOSTAT
COPPER HOT WATER TRAP
SWEAT TYPE FITTINGS (RED BRASS)
BAKELITE SEALED-IN CALROD UNIT (UPPER)
HOT WATER OUTLET FASTENED RIGIDLY TO CASING ¾ INCHES
TRIM PLATE
THIN WALL RIGID CONDUIT
ROCK WOOL INSULATION
STEEL HOUSING
GALVANIZED TANK 300-POUND TEST PRESSURE
LOWER THERMOSTAT
BAKED ENAMEL FINISH
BAKELITE SEALED-IN CALROD UNIT (LOWER)
COLD WATER SUPPLY ¾-INCH PIPING
PRESSURE RELIEF VALVE
PROVISION FOR SEALING COVER
TO DRAIN
TOE SPACE-3 INCHES DEEP
ALL WELDED BASE CONSTRUCTION
DRAIN COCK
4-INCH BASE

Figure 64. Cutaway of a Typical Electric Hot Water Heater

2. They are designed for quiet operation.

3. They are cleaner operating.

LOCATING WATER HEATERS

Locating a water heater is important to the architect and plumber when installing a hot water heater. This will insure sufficient amounts of hot water at all times.

In a new installation, check the blueprints or plans for correct location of the water heater. It is good practice to locate hot water heaters and tanks as close as possible to hot water risers to shorten the distance the water must flow to reach the fixture. When hot water is drawn, all the cold water in the pipes must flow before the hot water will reach the faucet. After the faucet is turned off, the water in the pipes will cool. If the water heater cannot be placed near the riser, a great amount of savings and efficiency of the hot water system can be maintained by covering long lines of piping with some type of insulation.

SIZING HOT WATER REQUIREMENTS

When sizing a building for hot water needs, a few items have to be considered:

1. Number of bathrooms.

2. Number of bedrooms.

3. How many and what type of automatic appliances will be installed. The chart in figure 65 illustrates a minimum recommendation for a normal average hot water requirement.

MINIMUM Recommendations for Normal Average Hot Water Requirements

Number of Bathrooms	Number of Bedrooms	Minimum Storage Capacity Required
1	1	20 gallons
1	2 or 3	30 gallons
2	2 or 3	40 gallons
3	3 or 4	50 gallons

With automatic clothes or dishwasher, use larger size.

Figure 65. Hot Water Requirement Chart

Practical Consumption

Practical tests reveal that the amount of water used by an individual will range from two to ten gallons per hour. Of course, this depends upon the type of building in which the system has been installed and the purpose for which the water is used.

INSTALLATION OF A GAS HOT WATER HEATER

Manufacturers supply rough-in specifications for their water heaters so pipes can be aligned accurately with heater outlets. A gas fired heater should be located where an adequate amount of air is available for combustion. Local codes should be complied with before installing a gas fired heater. Their flues cannot be near combustible materials. Figure 66 illustrates a typical gas fired hot water heater installation.

Venting Water Heaters

Each flame-type water heater should be equipped with a suitable draft diverter or vent hood as shown in figure 67. This prevents a downdraft from affecting combustion or blowing out the pilot light. It is good practice to locate a flame type water heater where it can be vented through the roof or an inner chimney. If the flue is connected to a chimney, the flue slope should not be less than 1/4 inch per foot. A three- or four-inch flue is large enough for the type water heater used for domestic use. Since the electric water heater does not have any escaping fumes it is not necessary for it to be vented.

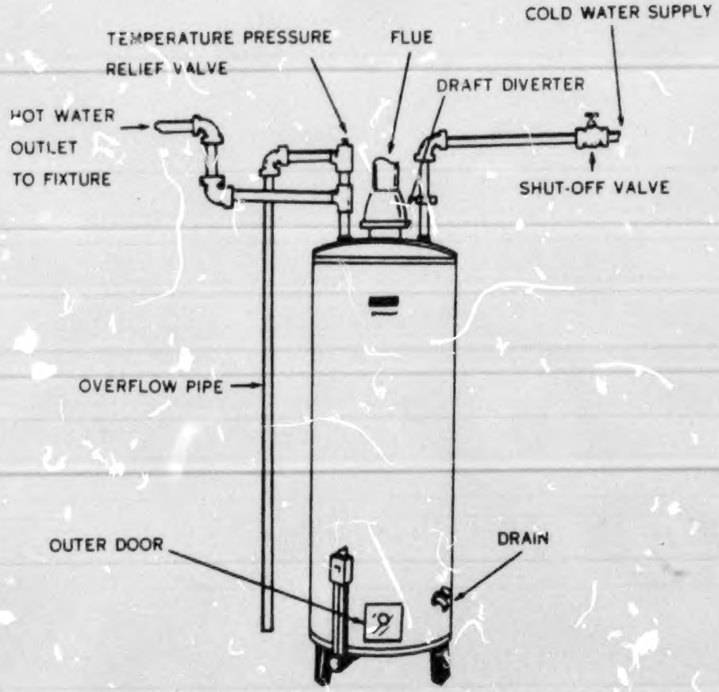

COLD WATER SUPPLY
TEMPERATURE PRESSURE RELIEF VALVE
FLUE
DRAFT DIVERTER
HOT WATER OUTLET TO FIXTURE
SHUT-OFF VALVE
OVERFLOW PIPE
OUTER DOOR
DRAIN

Figure 66. Typical Gas Hot Water Heater Installation

Installation of Water Piping

When installing a hot water heater, the type of heater, whether it is a new installation or replacement, will determine the type of tools to use. The rough-in measurements for a new installation of a hot water heater will be determined by the manufacturer. It remains for the plumber to install the risers to the height specified for proper fixture connection.

The heater outlets for connecting hot and cold water pipes are marked on top of the heater near the opening. If the heater is not marked, the hot water outlet is usually on the left as viewed from the front of the heater. The cold water supply pipe should not be smaller than 3/4 inch and should be provided with a gate valve placed near the tank to cut off the water supply. The hot water line from the heater should not be smaller than 3/4 inch galvanized pipe or 3/4 inch copper tubing.

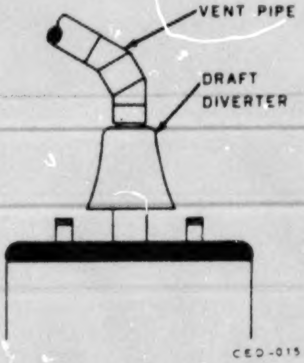

VENT PIPE
DRAFT DIVERTER
CED-015

Figure 67. Vented Water Heater

Unions are placed in the hot and cold water lines to quickly disconnect the lines when it is necessary to replace the heater. A drain drip pipe is installed to the relief valve and extended at least to within six inches of the floor.

If galvanized piping is used in the hot and cold water supply system, all piping must be cut, reamed, threaded, and joint compound applied to the threads before assembly and final connection.

If copper tubing is used for the hot water piping system, you should cut, bend, flare, or sweat, depending on the location of the heater.

When using two dissimilar metals in piping hookup such as copper and galvanized pipe or tubing, a dielectric union should be installed to prevent electrolysis. Pipe hangers and clamps should be made of the same materials as the pipe to prevent electrolysis.

After all hot and cold water piping has been properly installed, the system must be filled with water and checked for leaks. If a leak is detected, you should repair the leaking joint by removing and replacing the pipe and/or fitting.

Safety of Water Heaters

Every type of hot water tank should be safeguarded against the possibility of an explosion that can be caused by superheated water due to the failure of an automatic cutoff or the neglect of not turning off a manually controlled heater. Few people realize that a single pound of water, changed into steam, under certain pressure and temperature conditions, can release over two million foot-pounds of explosive energy. This is more than could be released by a pound of nitroglycerine and is more than enough force to shatter a building. Water heaters require a safety valve to be installed on the outlet side of piping to water heater. The type valve preferred is the temperature and pressure safety valve. This valve is set at 125 pounds working pressure and 210°F.

Installing Gas Service

Installing gas piping lines within a building is accomplished in the same manner as waterlines; that is, the black iron piping for the gas system is cut, reamed, threaded, and the joints coated with joint compound the same way as galvanized water piping.

Black iron piping is largely used in gas distribution. If galvanized pipe is used, the gas will cause the galvanize to flake off and stop the flow of gas through the fixture orifice.

Hookup of Gasline

The minimum size black iron gas pipe that should be installed to a gas water heater is 1/2 inch. A union should be installed in the lines so it can be easily disconnected when it is necessary to replace the heater. Some city codes may permit the plumber to install a short length of copper tubing to the heater to take the place of the union. A plug type valve (gas cock) should also be installed in the line so the gas can be cut off when it is necessary to remove or service the heater. When installing gas lines, be sure they are supported with proper hanger supports. Only approved threaded pipe and fittings or flared tubing should be used. Do not use "SOLDER" joint.

370

Testing for Gas Leaks

After the gasline has been properly installed and before the system is put into service, it must be tested for leaks. Leakage of gas is not only wasteful but also constitutes a serious hazard. Therefore, check a gas system more closely than a water system.

In testing a gas system some element such as peppermint is added to the gas to give it an odor. Possible leaks can then be detected, but frequently even this type of test may allow the gas to leak for a long time before it is detected.

The simplest test for leaks at joints or valves is the application of soapsuds to the suspected surface. Bubbles will appear on the pipe surface if there is any indication of a leak.

If a leak is detected it should be repaired immediately. If the leak is a defective pipe or fitting, it should be replaced. If it is a leaky valve, it must be repaired.

Servicing Heater

Before the gas cock is opened make sure the thermostat is opening and closing. This is accomplished by turning the adjusting dial back and forth on the low temperature end of the scale until a click is heard. The clicking sound signifies that the thermostat is opening properly. After this test, set the thermostat adjusting dial to normal (140°) for ordinary use.

To assume maximum protection from gas fumes, it is important to have a gas fired water heater that is equipped with some type of safety controls. (See figure 68.) These automatic controls automatically shut off the gas to the main burner when the pilot light goes out. As long as the thermocouple is heated by the pilot light it will keep the main burner valve open but when the pilot goes out the thermocouple cools off, causing the gas valve to the main burner to close. The thermostat that extends into the hot water tank controls the gas going to the main burner. The thermostat is controlled by the temperature of the water inside the tank.

After the pilot light has been burning for about five minutes it should be adjusted so it will have a soft blue flame and be about 3/4 inch high. This is accomplished by means of the pilot air shutter on some models and adjusting screw on others. The pilot light should be adjusted at the same time as the main burner so it will have a soft blue flame.

Water heaters made by different companies have different patents for their heating units and automatic controls. As a plumber you will be required to make certain adjustments located in different positions on the heating units. Follow the step-by-step procedure given on the metal service plate mounted on each water heater and always keep in mind, for proper efficiency of any type water heater, it must be properly installed and adjusted.

Very little maintenance is required of a hot water heater. Occasionally the tank should be flushed to remove scale and rusty water that is caused by scaling action. Pipes should be checked for leaks. The draft flue should be inspected to see that it is in the correct position. The burners should be cleaned when necessary.

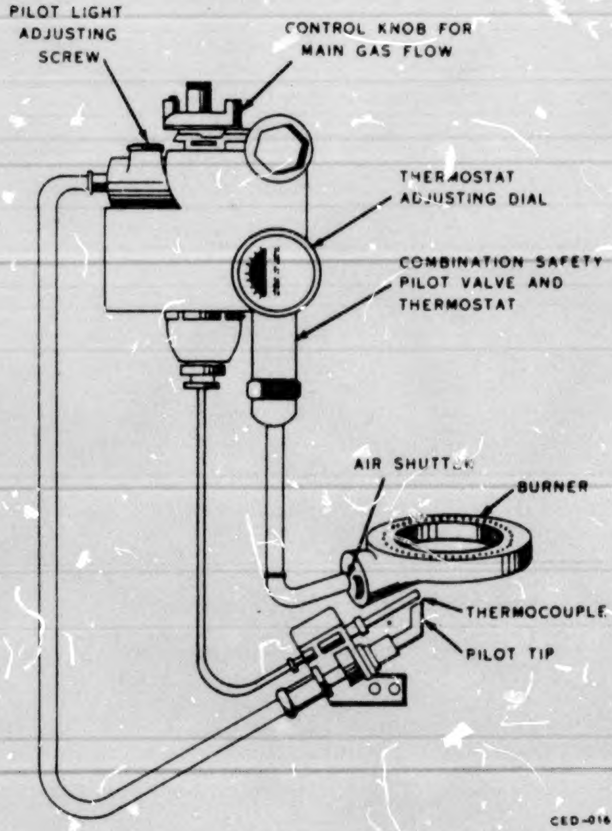

PILOT LIGHT ADJUSTING SCREW
CONTROL KNOB FOR MAIN GAS FLOW
THERMOSTAT ADJUSTING DIAL
COMBINATION SAFETY PILOT VALVE AND THERMOSTAT
AIR SHUTTER
BURNER
THERMOCOUPLE
PILOT TIP
CED-016

Figure 68. Automatic Safety Controls and Burner Assembly

SUMMARY

A water heater may have excellent features but if it is not properly located and sized it will not serve its purpose. In locating gas fired water heaters keep in mind they cannot be located near combustible materials, they should be located as close as possible to hot water risers, be located where they can be vented and have enough air for combustion. The heater will be the correct size if you take into consideration the design of the building, the number of occupants and heating capacity of the unit.

Correct installation of the piping to the hot water heater is also important for proper operation of the system. Cold water lines to the heater should not be less than 3/4 inch in diameter. A union must be installed in the line for quick disconnecting of the pipe, also a gate valve for cutting off water supply and a check valve placed in the line to check the surge of water pressure. All water pipes must be cut, reamed, threaded, and the threads coated with joint compound before assembly. The hot water line should not be less than 3/4 inch in diameter. This line must also have a union for quick disconnecting the line and all piping and fittings installed the same way as the cold water piping. The hot water side of the heater should also have a temperature-pressure relief valve and an overflow pipe connected to the relief valve.

The gasline to the water heater should not be less than 1/2 inch in diameter and the piping should be black iron because galvanized flakes stop the flow of gas through the fixture orifice. The line should have a plug type valve for cutting off the gas and a union for quick disconnecting the line. All gaslines should be installed using the same procedure as installing hot and cold water lines.

After all water and gaslines have been properly installed, they must be tested for leaks. The hot and cold water lines are tested by turning on the water and visually checking for leaks. If leaks are detected the pipe or fitting must be removed and replaced. The gasline is tested by turning on the gas and applying soap bubbles to the joints. If a bubble forms, the pipe or fitting must be removed and replaced.

QUESTIONS

1. List some of the better features of the water heaters used today.

2. What items do you need to take into consideration when locating a water heater?

3. Name the three things that must be considered when sizing a water heater.

4. What is the purpose of a draft diverter?

5. What size flue is used on a water heater used for domestic use?

6. How can you determine the hot water pipe outlet if it is not marked on the heater?

7. Why is black iron piping used for the gas piping system?

8. How do you test a gasline for leaks?

9. What degree temperature setting is considered normal for a hot water heater?

10. What safety mechanism is installed in the hot water line of a water heater?

REFERENCES

1. AFM 85-20, Plumbing.

2. Plumbing Installation and Repair, Manly.

3. National Plumbing Code Handbook, Manas.

522 373

WORKBOOKS 3ABR55235-III-1-P1 thru 7-P1

Department of Civil Engineering Training

Plumbing Specialist
Block III

EXTERIOR AND INTERIOR WATER SUPPLY SYSTEMS

2 December 1974

SHEPPARD AIR FORCE BASE

Designed For ATC Course Use

DO NOT USE ON THE JOB

TABLE OF CONTENTS

WB 3ABR55235-III-1-P1 1

WB 3ABR55235-III-2-P1 3

WB 3ABR55235-III-3-P1 6

WB 3ABR55235-III-4-P1 10

WB 3ABR55235-III-5-P1 13

WB 3ABR55235-III-5-P2 14

WB 3ABR55235-III-5-P3 15

WB 3ABR55235-III-5-P4 17

WB 3ABR55235-III-5-P5 20

WB 3ABR55235-III-6-P1 21

WB 3ABR55235-III-7-P1 27

This supersedes WB 3ABR55235-III-1-P1 thru 7-P1, June 1973 (Copies of the superseded publication may be used until the supply is exhausted.)

Department of Civil Engineering Training
Sheppard Air Force Base, Texas

WB 3ABR55235-III-1-P1
2 December 1974

CONSTRUCTING A WATER DISTRIBUTION SYSTEM

OBJECTIVE

The purpose of this workbook is to aid you in reading drawings and the use of tools for cutting cast-iron pipe.

Standards of performance:

The identification of all components will be correct, and the class will cut 4-inch cast iron using a chain cutter and chain tongs.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-1	1/student
WB 3ABR55235-III-1-P1	1/student
Cast-iron pipe	1/student
Sample Board of Plumbing Hardware	1/class
Shop Tools	1/2 students
Map of Base Water Distribution System	1/4 students

PROCEDURE

Mission 1

Using figure 1 identify all components.

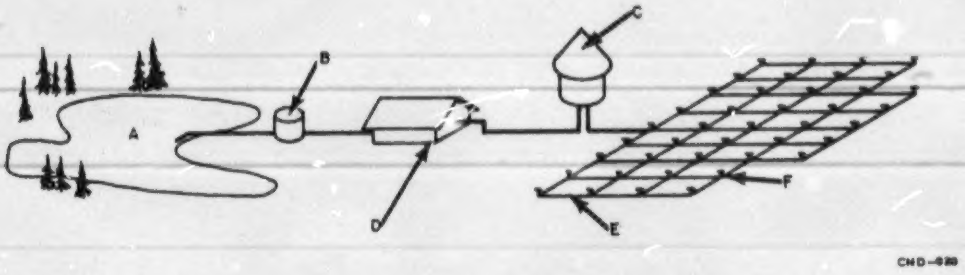


Figure 1. Water Distribution System

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

376

Mission 2

Cut a piece of cast iron 6" long, using a chain cutter and chain tongs.

1. Procure tools and pipe.
2. Measure and mark pipe.
3. Fasten chain tong to pipe.
   a. Wrap chain around pipe.
   b. Select chain knuckle that properly fits pipe and insert it into notch.
   c. Lift handle until teeth grip pipe.
4. Place cutter on mark.
   a. Select chain knuckle as in step b above.
   b. Align cutting wheels on mark.
   c. Snug up chain by tightening tension nut.
   d. Move handle back and forth until pipe is cut.

408

CUTTING, THREADING, AND ASSEMBLING STEEL PIPE

OBJECTIVE

Upon completion of this unit of instruction, you should be aware of the procedures for cutting, reaming, and threading pipe, using a power threader and you should be able to assemble steel pipe and fittings.

Standard of performance:

All answers and procedures will be correct.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-2	1/student
WB 3ABR55235-III-2-P1	1/student
Power threader	1/class
Tool kits	1/2 students
AFM 85-20	1/2 students

PROCEDURE

Mission 1

1. List four types of holding devices.

____

____

____

____

2. What is the maximum amount the pipe cutter should be tightened per revolution? ______________________________

3. After cutting the pipe to length, it must be ______________.

4. An adjustable die and stock set eliminates the need for ________ ______________ ______________ ______________.

5. What are three methods of measuring pipe? ______________

______________________ ______________________

Mission 2

To give you a better understanding of the power threader and how it must be operated, follow the procedures listed below.

1. Preoperational Check
   a. Check power cord and ground.
   b. Check oil level in sump.

c. Select die head required.

d. Set die head to proper size.

2. Operation

NOTE: This sequence must be accomplished from memory.

a. Insert pipe in machine so length of pipe to be cut extends sufficiently away from chuck.

b. Support long pipe with pipe rest.

c. Close rear centering chuck.

d. Close front chuck by rotating counterclockwise.

e. Bring down cutter and place on mark. Turn on motor and cut pipe (do not tighten cutter over 1/4 turn per revolution of pipe).

f. Swing back cutter after use.

g. Bring down reamer and ream pipe.

h. Swing back reamer after use.

i. Bring down die head.

j. Check to see that die head is in the closed position.

k. Check that oil is flowing to die segments.

l. Use firm pressure until the dies take hold on pipe.

m. Let the machine self-feed until proper amount of thread is cut.

n. Lift the die head opening lever.

o. Back off carriage.

p. Raise die head.

q. Stop motor.

r. Loosen chuck and remove pipe.

3. Postoperational Check

a. After cutting all thread clear die head.

b. Remove chip tray and clean.

c. Periodically remove pipe plug from oil sump. Clean out sludge, chips, and foreign particles.

d. Check oil level in sump.

379

Mission 3

1. Assembling Threaded Pipe and Fittings

   a. Clean threads.

   b. Apply pipe joint compound to male threads only.

   c. Insert male threads in fitting (hand tight).

   d. Select proper size wrenches.

   e. Tighten pipe using backup. CAUTION: Do not overtighten.

411

TAPPING PRESSURIZED WATER MAIN

OBJECTIVE

The purpose of this workbook is to aid you in:

Locating and identifying and giving the purpose of building service line components.

Making a drawing of a building service line and a bill of materials.

Using a self-tapping machine.

Standard of performance:

All answers will be correct.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-3	1/student
WB 3ABR55235-III-3-P1	1/student
Plumber's Tool Kit	1/2 students
Water Main Self-Tapping Machine	1/class
Water Main Trainer	1/class
Special and Shop Tools	1/2 students
Samples of Plumbing Hardware	1/class

Mission 1

Using figure number 2, identify all of the components in the building service line.

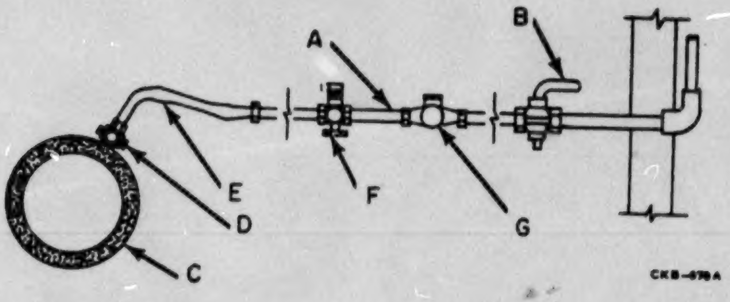


Figure 2, Building Service Line

a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

f. ______________________

a. ____________________ e. ____________________

b. ____________________ f. ____________________

c. ____________________ g. ____________________

d. ____________________

Mission 2

Using figure 2, make a bill of materials.

____________________ ____________________

____________________ ____________________

____________________ ____________________

____________________ ____________________

____________________ ____________________

____

____

Mission 3

1. Water main tapping machine parts identification.

Identify components of the water main self-tapping machine, figure 3, by placing numbered parts by correct name.

1. Saddle ______
2. Flop Valve Handle ______
3. Flop Valve ______
4. Bypass ______
5. Boring Bar ______
6. Friction Collar ______
7. Cylinder ______
8. Drill and Tap ______
9. Feed Yoke ______
10. Ratchet Handle ______
11. Gasket ______
12. Cap ______

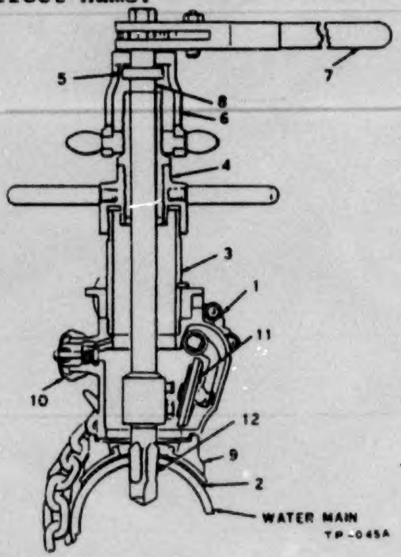


Figure 3. Water Main Tapping Machine

2. Procedures for tapping the main.

a. Select a location for the tap at the top of the water main.

b. Clean all rust and dirt from the area.

c. Place the gasket on the water main and set and saddle the water main self-tapping machine on the gasket.

d. Encircle the water main with the chain and tighten the bolts evenly until a solid, watertight connection is formed between the main and the machine saddle. Use level to keep machine plumb.

e. Remove the cap from the cylinder of the water main self-tapping machine and install the required size combination drill and tap into the boring bar.

f. Apply special grease to the drill and tap. This will lubricate and help cool the drill while boring through the wall of the water main. Oil friction collar.

g. Reassemble the machine and tighten the cylinder cap.

h. Start drilling the hole by applying pressure at the feed yoke while operating the ratchet handle. After the drill has penetrated the main, the boring bar will turn easily until the tap starts cutting threads.

i. Once the tap starts threading the hole, back the feed yoke off to prevent stripping the threads in the hole.

j. Continue turning the boring bar until the depth adjustment is even with the top of the friction collar.

k. To remove the tap from the hole, reverse the ratchet and back the boring bar out by turning it in a counterclockwise direction.

> CAUTION: Care must be taken because the water pressure will cause the boring bar to rise rapidly and could injure the operator.

l. Close the flop valve and open the bypass valve by turning counterclockwise to prevent water from entering the cylinder.

> NOTE: The water under pressure from the main is now tapped in the machine base and the boring bar can be removed by unscrewing the cylinder cap.

m. Remove the drill and tap combination and install the proper size corporation stop in the adapter at the end of the boring bar.

> CAUTION: Be sure the corporation stop is in the closed position.

n. Since the corporation stop was closed before being installed, the only water which can now leak out is the water which was trapped in the cylinder of the machine.

o. Release the water by turning the bypass valve clockwise

p. Remove the boring bar.

q. Disengage the chain from the main and carefully remove the machine.

r. Dry the machine and coat it with oil lightly before storing.

s. Check for leakage around the corporation stop. If there is a leak, tighten the corporation stop with an 18" smooth jawed wrench. NEVER USE A PIPE WRENCH ON THIS VALVE.

INSTALLATION OF BUILDING COLD WATER DISTRIBUTION SYSTEMS

OBJECTIVE

The object of this workbook is to aid you in:

Locating and identifying components of the cold water distribution system.

Making a sketch of your booth area system.

Constructing the cold water distribution system.

Standard of performance:

All drawings and answers must be correct.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-4	1/student
WB 3ABR55235-III-4-P1	1/student
Plumber's tool kit	1/2 students
Shop tools	1/class
Blueprints and drawings	1/4 students

PROCEDURE

Mission 1

Using figure 4 identify components of a building cold water distribution system.

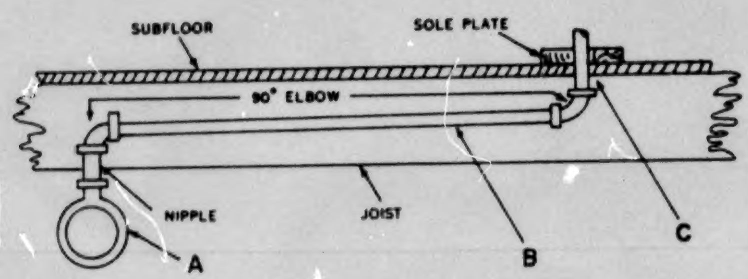


Figure 4, Cold Water Distribution System

a. ______________________________

b. ______________________________

c. ______________________________

Mission 2

Using the sketch below draw a cold water distribution system.

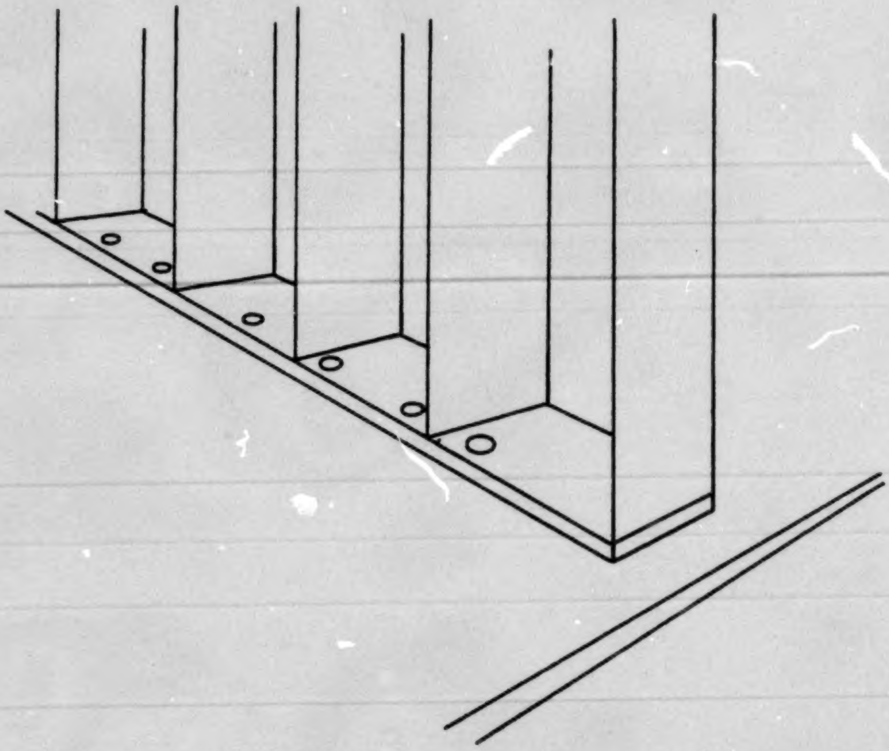


Figure 5

Mission 3

1. Using the drawing completed in mission 2 construct a water distribution system in your booth area.

2. Make a bill of materials for the distribution main and branches.

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

3. List tools and equipment necessary for installation of the cold water distribution main and branches.

____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

4. Measure, cut, and thread the pipe.
5. Assemble the prepared pipe.
6. Have the instructor check your work.

IDENTIFYING PIPES

OBJECTIVES

When you have completed this project you will be able to identify five types of copper tubing.

Standard of performance:

All samples must be identified correctly.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-5	1/student
WB 3ABR55235-III-5-P1	1/student
Samples of Copper Tubing	1/class

PROCEDURE

From samples of copper tubing, identify each of the labeled items.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

BILL OF MATERIALS

OBJECTIVES

This project will give you practical experience in making a bill of materials for installation of the hot water distribution system for your booth area.

Standard of performance:

The bill of materials must contain all the necessary items to construct the hot water distribution main.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-5	1/student
WB 3ABR55235-III-5-P2	1/student

PROCEDURE

Using the working drawing below, make a list of materials required to construct a hot water distribution system in the booth area.

________________________________ ________________________________

________________________________ ________________________________

________________________________ ________________________________

________________________________ ________________________________

________________________________ ________________________________

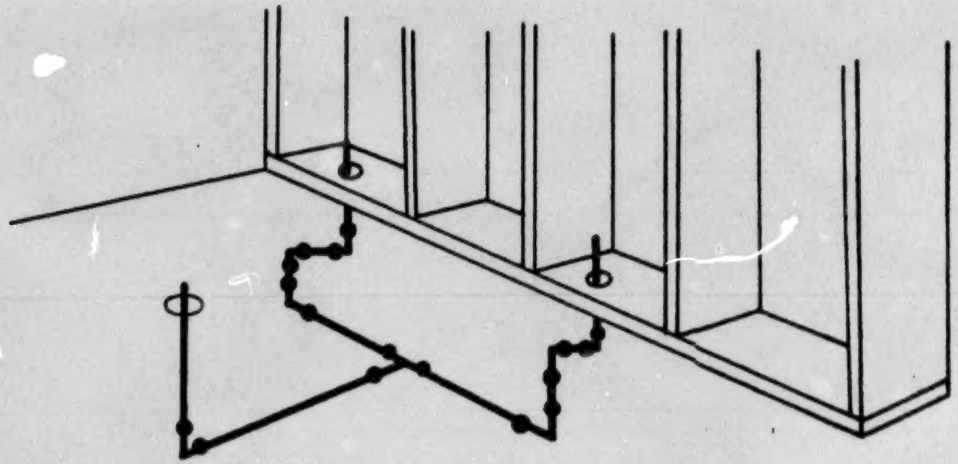


Figure 6

ASSEMBLING FLARED AND SOLDERED COPPER JOINTS

OBJECTIVE

To aid you in developing skill in bending, cutting, flaring, assembling, and testing copper tubing.

EQUIPMENT

	Basis of Issue
WB 3ABR55235-III-5-P3	1/student
1/2-inch copper tubing	1/student
1/2 tube bender	1/2 students
Flaring tool	1/2 students
Swaging tool	1/2 students
Plumber's tool kit	1/2 students

PROCEDURE

1. Follow the steps below in fabricating the tubing assembly shown in figure 7. Observe safety precautions during the assembly procedure.

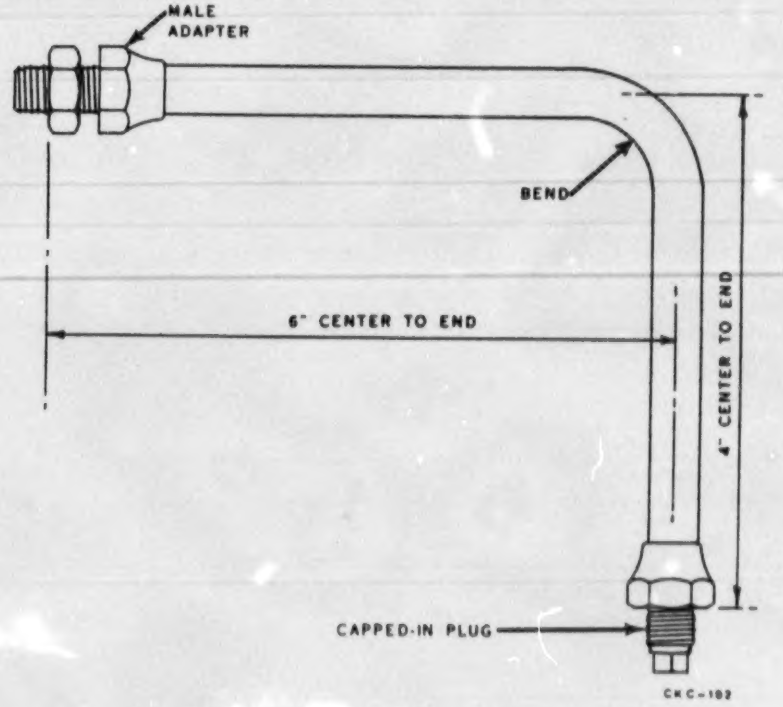

MALE ADAPTER
BEND
6" CENTER TO END
4" CENTER TO END
CAPPED-IN PLUG
CKC-102

Figure 7. Tubing Assembly

a. Study figure 7 and with the aid of your instructor, secure the materials and tools you will need to fabricate the assembly.

b. Cut copper tubing to length with either a mechanical tubing cutter or a fine-toothed hacksaw blade.

NOTE: Make sure the ends are cut square when using the hacksaw.

c. Ream the ends of the tubing.

d. Bend the tubing using a mechanical tube bender.

NOTE: Your instructor will give you measurements for the correct size bend.

e. Place flare nuts over each end of the tubing before flaring.

NOTE: This is the normal procedure when laying long runs of tubing.

f. Insert each end of tubing in proper flare block opening.

g. Flare all tubing connections.

NOTE: A flare block and flare plug may also be used to make the flare.

h. Assemble the flare fittings and tighten connections.

i. Install the plug and male adapter (see figure 7).

j. Connect assembly to test manifold.

k. Check each connection for proper tightness.

l. Pressure test the assembly.

m. Have instructor check your work.

n. Disassemble and return usable tubing and fittings to storage.

o. Place unusable material in proper container.

p. Clean tools and return them to their proper storage.

q. Clean work area.

Swaging and Soldering

OBJECTIVE

This project will give you practical experience in swaging and soldering copper tubing.

Standard of performance:

The completed project must not leak.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-5	1/student
WB 3ABR55235-III-5-P4	1/student
Soldering equipment	1/2 students
Swaging tool	1/2 students
6-ft rule	1/2 students
Copper tubing and fittings	1/class
Plumber's tool kit	1/2 students

PROCEDURES

1. Swage and solder a copper tubing.

a. Cut and ream two pieces of copper tubing approximately 3 inches in length.

b. Insert one piece of copper tubing in the flaring block as illustrated in figure 8.

NOTE: Figure 8 illustrates the amount of tubing to be left above the flaring block.

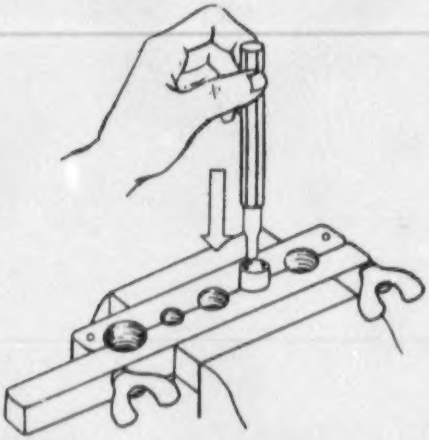


Figure 8. Operating Swaging Tools

c. Insert the combination swaging tool in the tubing as illustrated in figure 8.

d. Use light strokes with a ball peen hammer and drive the swaging tool into the tubing (see figure 9).

NOTE: The swaging tool should be turned slightly after each stroke.

e. Remove the swaging tool.

f. Remove the tubing from the flaring block.

g. Use steel wool or sandpaper and clean the ends of the tubing to be soldered.

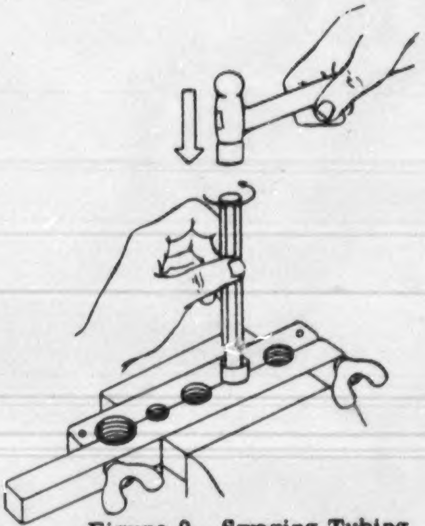


Figure 9. Swaging Tubing

NOTE: To make a good soldered joint, the tubing must be absolutely clean.

h. Cover each surface to be soldered with a thin coat of flux.

i. Insert one piece of the tubing into the other tubing as illustrated in figure 10.

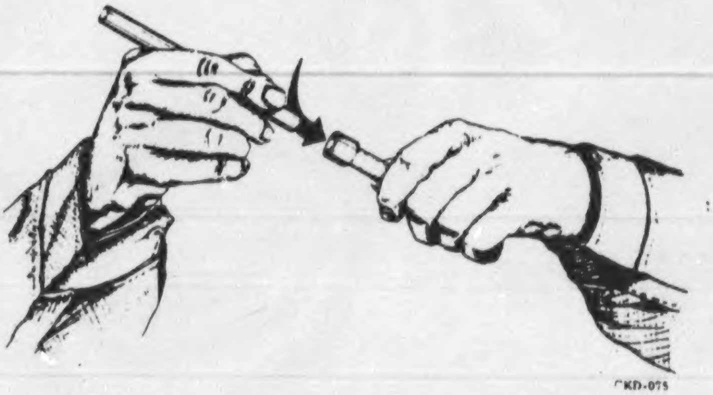


Figure 10. Inserting Tubing

2. Fabricate the system illustrated in figure 11 using 5/8" copper pipe on fittings.

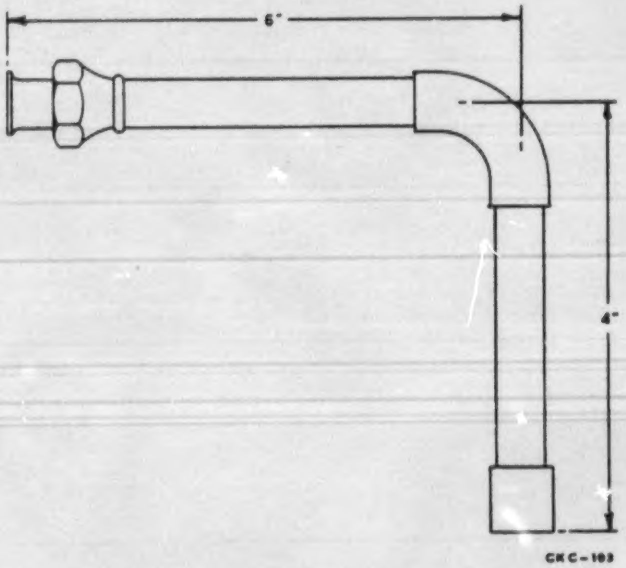


Figure 11

a. Cut copper tubing to length, assemble fittings, flare, and solder joints.

b. Test for leaks by connecting the flared end to water pressure.

(1) Did your fittings leak? Yes/No.

(2) Can you make solder repairs on tubing containing water? Yes/No.

c. With water pressure applied, attempt to remove the pipe cap by applying heat.

(1) Did you get the pipe cap off? Yes/No.

(2) Did the solder melt? Yes/No.

d. Using your own method, remove the pipe cap.

(1) Did you remove water pressure and drain the water? Yes/No.

(2) Can a soldered joint be melted loose when the fitting is full of water? Yes/No.

WB 3ABR55235-III-5-P5

MAKING A FERRULED CONNECTION

OBJECTIVE

This project will give you practical experience making a ferruled connection.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-5	1/student
WB 3ABR55235-III-5-P5	1/student
Copper tubing and fittings	1/student
Plumber's tool kit	1/2 students

PROCEDURES

1. Measure and cut a piece of 3/8" tubing 3 inches long.
2. Ream and dress one end of the tubing.
3. Place the compression nut on the tubing.
4. Place the compression ring on the tubing.
5. Install the compression nut on the fitting and tighten.
6. Have the instructor check your work.

ROUGH-IN WATER SUPPLY FOR BATHROOM FIXTURES

OBJECTIVES

This project will give you practical experience using manufacturer's rough-in specifications to rough-in the water supply for bathroom fixtures.

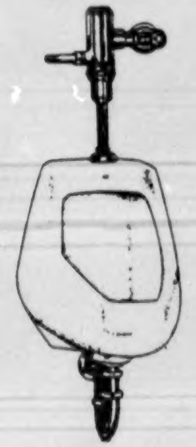
EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-6	1/student
WB 3ABR5523-III-6-P1	1/student
Plumber's tool kit	1/student
Shop and special tools	1/2 students
Pipe and fittings	1/class
Manufacturer's rough-in specifications	1/class
Engineering drawings	1/class

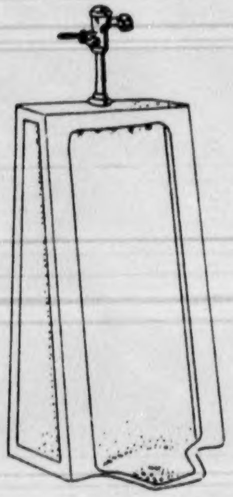
PROCEDURE

Mission 1

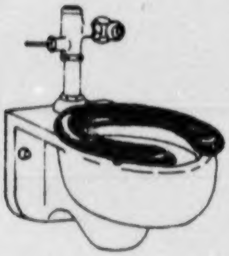
1. Identify the following items.



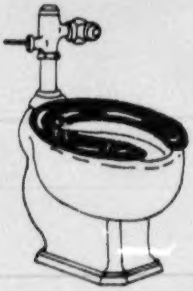
a. ______________________



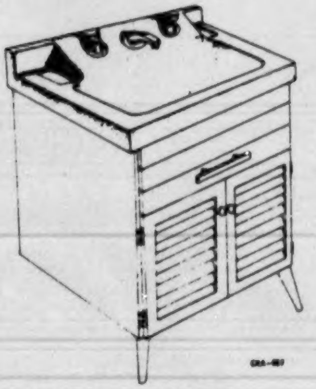
b. ______________________



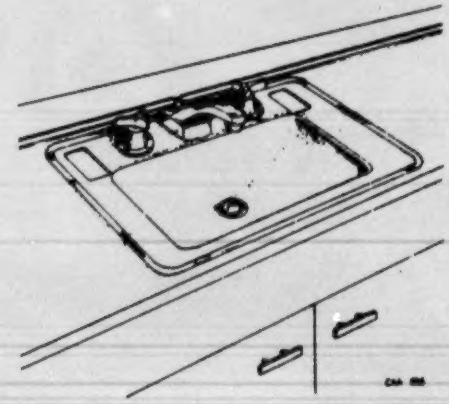
c. ______________________



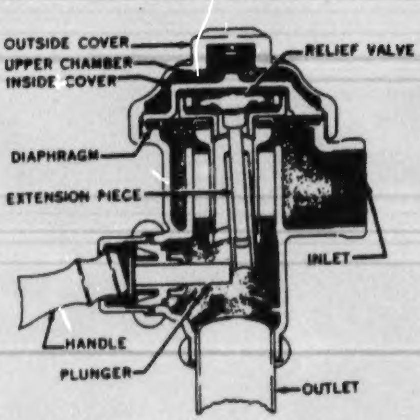
b. ______________________



e. ______________________________



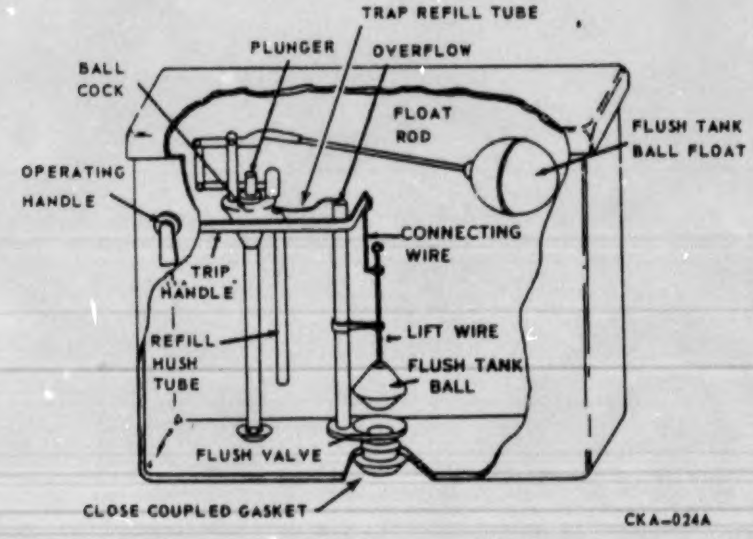
f. ______________________________


OUTSIDE COVER
UPPER CHAMBER
INSIDE COVER
RELIEF VALVE
DIAPHRAGM
EXTENSION PIECE
INLET
HANDLE
PLUNGER
OUTLET

g. ______________________________

Figure 12 (Continued)

428


TRAP REFILL TUBE
PLUNGER
OVERFLOW
BALL COCK
FLOAT ROD
FLUSH TANK BALL FLOAT
OPERATING HANDLE
CONNECTING WIRE
TRIP HANDLE
REFILL HUSH TUBE
LIFT WIRE
FLUSH TANK BALL
FLUSH VALVE
CLOSE COUPLED GASKET
CKA-024A

h. ______________________________

Figure 12 (Continued)

Mission 2

This project will help you learn how to use manufacturer's rough-in specifications. The measurements obtained WILL NOT be used in your booth, because the fixtures to be installed are not all the same model. When you have completed this project have your instructor check your answers. After verifying that your answers are correct, he will then tell you how to obtain the measurements that you will need in your booth.

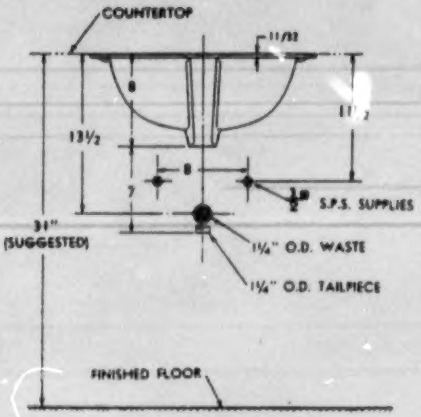

COUNTERTOP
11/32
8
11½
13½
8
7
½" S.P.S. SUPPLIES
31" (SUGGESTED)
1¼" O.D. WASTE
1¼" O.D. TAILPIECE
FINISHED FLOOR

Figure 13

1. Using the lavatory rough-in specifications above, answer the following questions:

a. What is the height from the finished floor to the center of the waterlines?

____

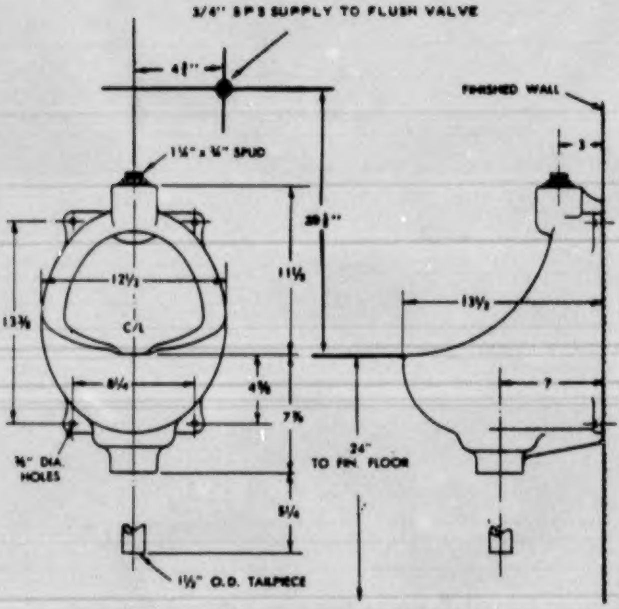
b. What is the center-to-center measurement between the waterlines? ______________

c. The size piping to be used for the water supply lines is ______________________.

d. What type of lavatory is this manufacturer's rough-in specification for?

____

398



3/4" SPS SUPPLY TO FLUSH VALVE
4¾"
FINISHED WALL
1¼" x ¾" SPUD
3
20¾"
11⅛
12½
13½
13⅞
C/L
8¼
4⅜
7⅞
¾" DIA. HOLES
24" TO FIN. FLOOR
7
5¼
1½" O.D. TAILPIECE
CKA-080

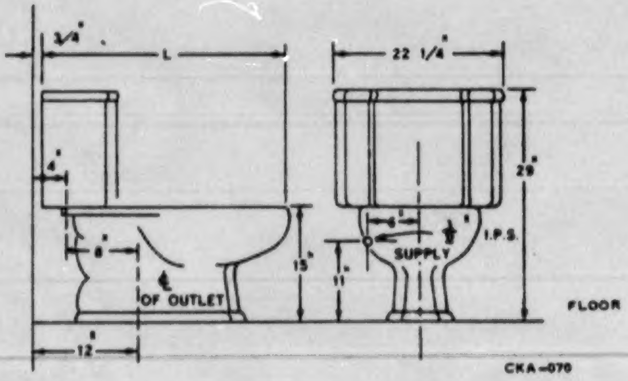
Figure 14

2. Answer the following questions using the urinal specification above:

a. What size will the supply line be to the flushometer valve?

____

b. What is the height from the finished floor to the center of the inlet to the flush valve? ______________________



3/4"
L
22 1/4"
4"
29"
6"
3/8"
I.P.S.
SUPPLY
8"
15"
11"
℄ OF OUTLET
FLOOR
12"
CKA-070

Figure 15

430

c. The measurement from the center of the urinal to the center of the water supply pipe will be ______________________

3. Using the water closet rough-in specification above, complete the following statements:

a. The water supply will be roughed in at ______ inches from the finished floor and ______ inches to the left of the centerline of the water closet.

b. This water closet will have a _______ inch water supply riser.

4. Use the tub and shower rough-in specification on this page when answering the following questions:

a. How many inches from the rough floor to the center of the spout hole?

____

b. The center of the mixing valve will be _______ inches from the finished wall and ______ inches from the rough floor.

c. The center of the shower arm hole will be _____inches from the floor.

d. The water supply pipes will be _______ inch SPS.

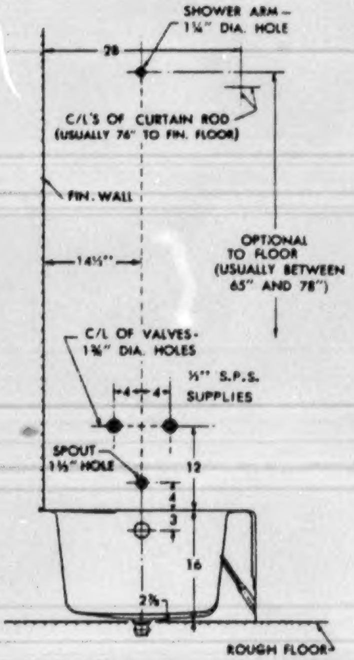

SHOWER ARM – 1¼" DIA. HOLE
28
C/L'S OF CURTAIN ROD (USUALLY 76" TO FIN. FLOOR)
FIN. WALL
OPTIONAL TO FLOOR (USUALLY BETWEEN 65" AND 78")
14½"
C/L OF VALVES- 1⅜" DIA. HOLES
4
4
½" S.P.S. SUPPLIES
SPOUT – 1½" HOLE
12
4
3
16
2⅜
ROUGH FLOOR

Figure 16

Mission 3

Upon completion of this project you will be able to rough-in risers for plumbing fixtures.

1. List the tools required to install the risers to the water closet, urinal, lavatory, and shower.

______________________ ______________________

______________________ ______________________

2. List the materials required to install the risers to the water closet, urinal, lavatory, and shower.

3. Have your instructor check these lists then begin installing the fixture risers.

401

INSTALLING A GAS WATER HEATER

OBJECTIVE

This project will give you practical experience identifying the major components of domestic water heaters and installing a domestic water heater.

Standard of performance:

1. Must correctly identify all the components of a domestic water heater.

2. The installed water heater must function correctly.

EQUIPMENT

	Basis of Issue
SG 3ABR55235-III-7	1/student
WB 3ABR55235-III-7-P1	1/student
Water heater	1/2 students
Plumber's tool kit	1/2 students
Shop tools	1/2 students
Pipe and fittings	1/class
Manufacturer's rough-in specifications	1/2 students

Mission 1

Identify the major compounds of a burner assembly.

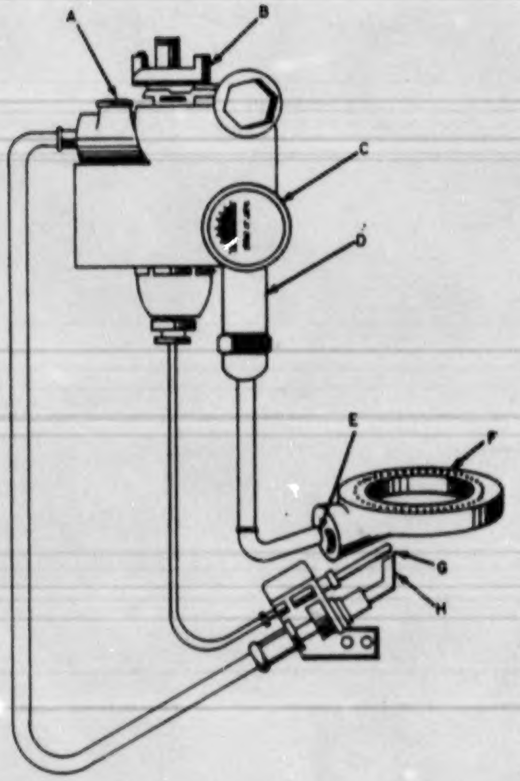

A
B
C
D
E
F
G
H
CED-616

Figure 17. Automatic Safety Controls and Burner Assembly

Mission 2

Identify the major components of a domestic water heater.

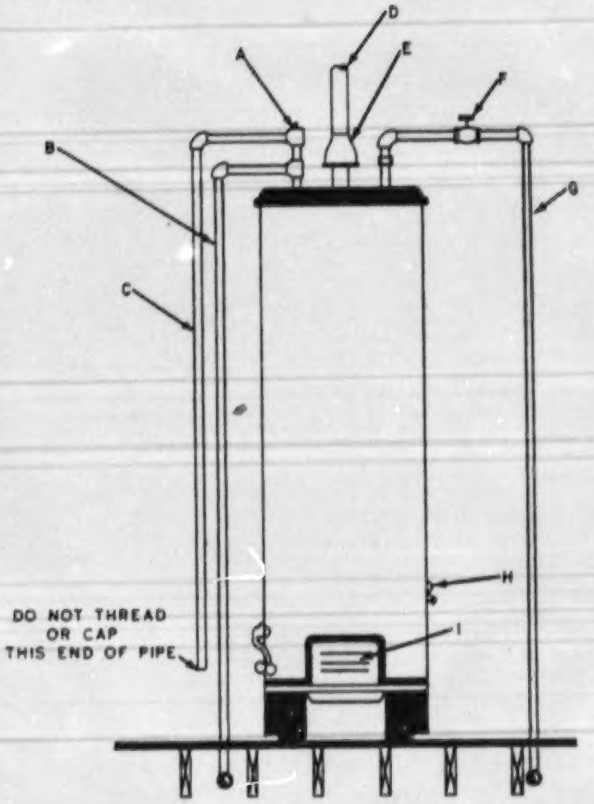

D
A
E
F
B
G
C
H
I
DO NOT THREAD
OR CAP
THIS END OF PIPE

Figure 18. Components of a Water Heater

Mission 3

1. Move the water heater into position.

NOTE: This procedure requires two men.

2. Measure and cut the tubing for the gas supply.

3. Explain where you can use copper tubing for gas supply. ________

____

____

4. Why can't you have a soldered connection in a gasline? ________

____

____

5. Install the gas supply line.

6. Check the gasline for leaks.

7. Explain how you check a gasline for leaks ____________________

____

____

____

8. Measure and cut the water supply line.

9. Install the water supply line.

10. Install the flue.

11. Fill the water heater with water.

12. Light the burner.

13. Set the thermostat at 140°F.

14. Observe the operation of the burner until the thermostat turns the flame off.

15. Check the temperature of the water.

16. Have the instructor check your work.

17. Clean up the area and return the tools and equipment to their storage area.